THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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(J. A. BERLY'S).

1911 EDITION

NOW IN PREPARATION.

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1911.

The New Year's come again,
Ah, well-a-day:
How soon they come,
How soon they pass away.

A FRIEND of ours not unconnected with the electrical industry said the other day, "I don't see how 1911 can be worse than 1910."

It must be admitted that in "These piping times of peace," with general trade booming, some departments of the electrical industry are not having too easy a time. We have laid the tramways, and arranged the lighting, and done a bit towards the power supply (how little by comparison with the total, was shown in Mr. Ferranti's brilliant Presidential address), and now we are waiting for the railways to call upon us to equip them and for power development to increase its speed.

And while we are waiting, Mr. Ferranti's great schemes for the production of energy at one-eighth of a penny per unit offer a dazzling prospect. But, unfortunately, he is again before his time.

Then what of the future? We can only propose to the electrical industry to prepare for better times. They are as sure to come as the day to follow the night.

We must continue to overhaul our designs and methods of business, by eliminating the unnecessary, and "scrapping" the obsolete. We must look to our commercial equipment. It is not enough to make a good article at a reasonable price. We must know how to sell it. And if money is to be spent, it cannot be better laid out than in sending the right kind of missionary (in a commercial sense) to foreign parts to look for trade.

Where individual efforts are not possible, combined efforts should be organised. Far be it from us to minimise the value of judicious advertising. But necessary as that is, it must be followed up by a man who knows the language, and the article he has to sell, and the rival article; and who has that rare quality—the ability to inspire confidence.

The capacity of hanging on doggedly is the Briton's great attribute. It is said that at Waterloo, towards evening, Napoleon asked one of his marshals, "Well, are they beaten?" "Yes, sire," was the reply. "Then why don't they go away?" asked Napoleon.

There must be a better time coming; everything goes in curves, and the curve is upward now. And though the improvement be not very perceptible, it will gain in strength.

For though the tired waves vainly breaking,
Seem here no painful inch to gain,
Far back through creeks and inlets making,
Comes silent, flooding in the main.

(A. H. CLOUGH.)

We conclude with a bit of "Reight Yorkshire":—

Here's a health to all of us. May we nivver
Want nowt, noan on us—nor me nawther.

1910: More Reflections.

Continuing the retrospect which we commenced in our last issue, it is interesting to note certain movements and tendencies which may exert a marked influence upon the future progress of our industry. Foremost among these is the development of the power load. In view of the profound influence exercised by the metallic-filament lamp upon the output of electricity works for lighting purposes, the countervailing growth of the output for motive power has been a most gratifying feature of the year, and has gone far, indeed, towards restoring that financial equilibrium which is so much to be desired. The larger cities, in fact, and many of the small ones, in spite of a reduced lighting load, have been compelled to take steps towards the early installation of additional generating plant, so that it would seem that the temporary halt in the work of extensions is drawing to an end. We feel that the improvement in the power load is one of the most satisfactory and auspicious features of the year's record.

We have already mentioned the fundamental changes in street-lighting practice which are being brought about by the metallic-filament lamp; those who may take the trouble to scan our "Lighting Notes" for the past year will be astonished at the number of towns and villages in which electric street lighting is being, or has been, introduced, and we confidently predict that the record of the current year will prove still more satisfactory in this respect, for the tungsten lamp offers ideal advantages for the purpose, and, at the prices for energy now prevailing, is able to defy the competition of gas, unless the latter is offered at less than cost for the sake of the advertisement.

Many small townships have agreed to take bulk supply from power companies and others, and in numerous cases the provisions of the new Act have been put in force to enable authorities to supply beyond their original statutory areas, a reform for which we cannot be too grateful. In this connection the use of overhead wires has shown a remarkable development; in many instances the local authorities, doubtless realising the fact that by no other means can they hope to obtain a supply of electricity, have themselves applied, or supported the applications of others, to the Board of Trade for the necessary permission. This is a healthy sign indeed; we have pointed out that it must come, if we are ever to reach the smaller townships on a commercially practicable basis, and we welcome the evidence of progress and enlightenment which it affords.

As regards the equipment of generating stations, while the steam turbine still retains its position of superiority in cost and efficiency in connection with large undertakings, it is significant to note that the Diesel engine has enjoyed an exceptional degree of popularity in smaller installations during the past year, and has justified the faith of the engineers responsible for its adoption.

Tramways have shown improved results during the year, and are being extended by a mile or so at a time in many instances, but few new projects have been put forward, and railway electrification is apparently almost at a standstill—though we believe that the subject is receiving constant and earnest consideration on the part of the railway companies. Railless traction, after having repeatedly cropped up during recent years, seems now in a fair way to wide adoption, a few projects having received Parliamentary sanction; there is not, we believe, a single example of it in commercial operation in this country as yet, but we anticipate that in our next retrospect we shall be able to point to a fair number. Electrical vehicles, unfortunately, have remained practically as they were, though there is here vast scope for profitable enterprise; we may suggest that co-operative action is desirable, to standardise apparatus, and to induce supply authorities everywhere to offer corresponding facilities for charging batteries.

The successful adoption of loading on the new Channel telephone cable, the improvements effected in wireless telegraphy, progress in electro-metallurgy, and numerous other subjects, would afford material for further comments—but our space is exhausted, and we must close this review.

The Aisgill Collision.

In our last issue we commented on the disaster on the Midland Railway, pointing out that the fire which followed the accident, due to the use of gas tanks on the train, and forming the most appalling feature of it, would have been avoided if electric lighting and cooking had been employed, and that the accident could not have happened if electric track signalling had been in use. We are glad to see that the same views have been urged in the *Times* and other leading organs of the daily Press, which have access to the general public, and that our contemporary, the *Railway Engineer*, is of the same opinion. The only chance of bringing about reform in these directions is by educating public opinion, which will then provide the necessary pressure without which the Board of Trade will not take action.

We trust, therefore, that the matter will not be allowed to fade into oblivion, as happens in so many similar cases, but that it will be kept in the foreground until active steps have been taken to provide the necessary safeguards.

The *Engineer*, discussing the signalling arrangements, endorses the claims made on behalf of electrical track signalling as a sure preventative of accidents of this nature, and points out that if it had been in vogue at Ormskirk, Willesden and Hawes Junction, the three recent accidents would not have occurred.

On the subject of fires, however, our contemporary is disposed to hold the view that coaches may be set on fire—and have been—by live coals ejected from the fire-box by the collision. We have on former occasions disputed the possibility of this happening.

Anyone who is familiar with the construction of a locomotive must be aware that it is almost impossible for live coals to be thrown out of the fire box at all; that they should be thrown backwards, over the tender, upon the coaches, when their motion must necessarily tend to throw them forwards against the tube plate, is simply inconceivable.

Much has been said in the Press also regarding the substitution of steel coaches for wood, and the use of fire-proof paint, &c. Neither of these measures, to our mind, would result in any material advantage. Wood is far preferable to steel in a collision; paint is utterly useless. The use of non-flammable wood, as on the Tube railways, would certainly be a commendable precaution, but—the first thing to do is to prevent collisions by the adoption of track signalling; the second, as trains may be wrecked by other means besides collisions, is to prevent fires by adopting electricity for lighting and cooking.

New Year Disappointment.

Our first impulse this week was to pass over the list of New Year Honours altogether, and say nothing about it. For what is there in it to interest electricians, electrical engineers, electro-commercial men, or even engineers—as such? Second thoughts, however, compel us once more to give expression to our usual grumble, though really it ought to be a louder one than ever. Has this Government no regard for the leaders in scientific research in electrical engineering and allied affairs? Has it no recognition to accord to men of sterling merit, reputation, and world-renowned achievement in these fields, or must we limp along with leaders whose praises are all unhonoured and unsung, because politics clamours? The railway world or the civil engineering profession does receive something, and we heartily congratulate Mr. James Charles Inglis, the general manager of the Great Western Railway, and twice President of the Institution of Civil Engineers, upon his knighthood. Mr. William Heerlein Lindley, M.Inst.C.E., a past president of the Junior Institution of Engineers, whose valuable services to the Royal Commission on Canals and Waterways will be well within our readers' recollection, also has a knighthood conferred upon him, which circumstance equally evokes our congratulations, for we have not

the least doubt that in both cases the honours are thoroughly well deserved. But they do not in the least temper our disappointment, rather the reverse, inasmuch as the Prime Minister and his advisers have come a step in the right direction and then fallen back. An honour that perhaps calls for mention here is the conferring of a baronetcy upon the Hon. D. P. de Villiers Graaf, the Minister of Public Works, Posts, and Telegraphs of the Union of South Africa.

The Industrial Position in America.

VERY various and strangely divergent views are being expressed just now by American business men as to the industrial outlook. From one quarter are vouchsafed pessimistic predictions of a "dreadful crash," though the authority credited with this comforting forecast followed close upon its track with a strong repudiation. Others do not go quite so far, but hold that in spite of fairly good crops the evidences of industrial awakening are "not promising for another year." As a relief comes the opinion of a New York paper that there need be no fear of disaster, as "fundamentals are too sound," though this authority adds that there is now being carried "a superstructure of overweighted costs which prevents industrial and commercial buoyancy." The public is assured, however, that "nobody need become panic-stricken," nor need anybody expect to be swept forward "on the high crest of a terrific boom." After studying these opinions (in a recent issue of the American *Literary Digest*) which leave us wondering just where American industry does stand at the moment, but also incline us to the belief that at least some of our cousins appear to be in just the right mood to precipitate a panic whether the inner state of things is congenial for it or not, we find a further pretty clear proof that all is not well in the views of Mr. H. H. Lewis. In the organ of the National Association of Manufacturers of America, this writer analyses present industrial conditions, using for his purpose statements made by 3,000 members of his Association. "To-day business is not good, it is only fair, and the country is not prosperous," is the conclusion at which Mr. Lewis arrives. A classification of the ills of industry follow and we quote these from the *Literary Digest:* (1) National irritation; (2) speculation; (3) internal dissension; (4) lack of confidence.

While lack of confidence naturally follows from (1), (2) and (3) it is not likely to be removed by forebodings of general crash and discussions of feared disaster. In this country our general trade position has greatly improved since confidence was restored throughout the world, and it is profoundly to be hoped that America, which was mainly responsible for this last deep depression in the industrial curve, is not going to shake the world's confidence again. As the result of Mr. Hill's diagnosis of the industrial disease which is at the bottom of all this, he advances the following as the cures advocated by the 3,000 manufacturers on whose behalf he writes:—

Less legislative interference with business.
Less political activity.
A speedy and equitable settlement of the railway-rate question.
More conservatism in business.
More national and individual confidence.
Take the tariff out of politics.
Give equal opportunities to all workmen by making the "closed shop" illegal.
Reforms of the currency and banking systems.
Prompt decisions in the important industrial questions now before the United States Supreme Court.
More attention to foreign trade and rehabilitation of the merchant marine.

These points are by no means, at any rate as regards the majority of them, peculiar to the United States position. Several of them have been advanced in this country again and again, in the interests of British industry.

Our own legislators, fresh returned from their appeal to the electorate, would be considering the best interests of the industries of the British Isles by applying some of these suggested American cures, for, as we have said repeatedly, British industry now requires—nay, demands—a rest from legislative interference. We want less of politics, and more of business.

NOTES ON DISTRIBUTION.

BY H. P. M.

THE question of distribution on low-tension systems is one which gives rise to many complications. It is a question which needs a great deal of forethought when laying out a scheme, but it is a greater problem when the present day central station engineer has to deal with it, and is handicapped by the existing load being altogether different to that which had been anticipated, and to mistakes made in the earlier stages of the undertaking.

The author has found on the systems with which he is acquainted that a great error has been made in putting too much copper in the feeders, and too little in the distributors, or, rather, the condition might be better expressed by saying that the number of feeding points is too few.

FIG. 1.

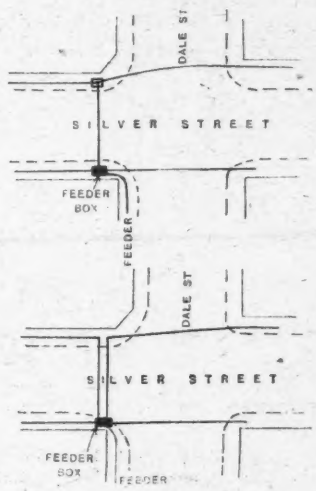


FIG. 2.

The great difficulty which now presents itself to the engineer is that, whereas the system was originally designed to meet a lighting load, it has now to deal with a power load equally as great, and in some cases greater. This, however, in itself would not be of very great importance except in the winter months, when the overlapping of these loads, brings up a peak load from 4 p.m. to 6 p.m.; then it is found that the mains are being badly overloaded in the vicinity of the feeding points, and the author has noted that a great many of the faults he has experienced on mains have been near such points, and have been most frequent in the early months of the year just after the period of the peak loads have gone off. Some of these difficulties can, however, be overcome at very little cost. One point which has frequently come under the observation of the author, is where the mains are run into the feeder pillars, or boxes, from the opposite sides of the road, these mains carrying for a short distance the load from both sets of distributors, yet having only the cross-section of one.

Fig. 1 shows the method which has been originally laid down; fig. 2 shows the more correct method, and one which can be easily adopted without a very great expense.

The question of keeping the voltage at the feeding points constant and equal is not so difficult, for the feeders of similar voltage drop can be grouped together and run off separate bars; in the larger stations it can be done to the extent of three sets of bus-bars, and in the smaller, with two sets, the bars being coupled up in parallel again as soon as the voltages become equal, or near enough to make the difference of very little consequence. If the station is only of small capacity, and it is not economical to run an independent set on separate bars, then the one set of bars can be boosted up through a small booster, or if a battery of sufficient size is installed, this could be run on one set of bars. This system of running the battery on a different set of bars has a great advantage in the case of the steam plant breaking down, for it will feed into the distributors with a

fairly large drop of potential, which will save the battery from receiving too great a rush of current, yet, at the same time, keep the mains alive, although at a greatly reduced voltage.

The greatest trouble, however, is experienced on those lengths of main which run out to dead ends, and on some systems it is impossible to avoid these, for it would be far too costly to link round, and is even impossible in some districts. A great mistake which is made in laying out these long lengths is that very often the mains are only laid on one side of the highway, whereas, it would be considerably better to have two mains, one on each side of half the section, these to be coupled together at intervals with three-way disconnecting boxes; it is found that this does not greatly increase the cost above the main laid on one side only, when several services have to be run across the road, also it allows for lengths of main to be cut dead, and yet maintain the supply at the far end of the system.

The author will now attempt to deal with this question of outlaying mains which are run to dead ends. Fig. 3 is a diagram which shows a length of 2,000 yards of ·4,·2,·4 sq. in. distributor which is run out to a distant point and there dead ended, the curves showing how the load is built up during the peak, that is, the day load plus evening load. It will, therefore, be seen that there is a drop in pressure equal to 53·9 volts to the far end; if the pressure of supply therefore is 440 volts across the outers, it means at the far end there is only a pressure of 396·1 volts, assuming that the voltage at the feeding point is kept at 450 volts, which means on consumers' lamps 198·05 volts, and also means that as the power consumers shut down, the voltage on the lamps rises by jumps. It will be noticed that these figures deal only with the outers, as the middle wire can usually be dealt with by means of balancers placed on the distributors.

Assume, for example, that the minimum pressure at any consumer is to be 215 volts, then this point is reached at a distance of 450 yd. from the feeding point, and is marked A in fig. 3; now examine the voltage chart and find a point where the drop in voltage to the end of the main is 20 volts, this then gives the uniform variation of 10 volts per side, which is quite large enough, and this point is found to

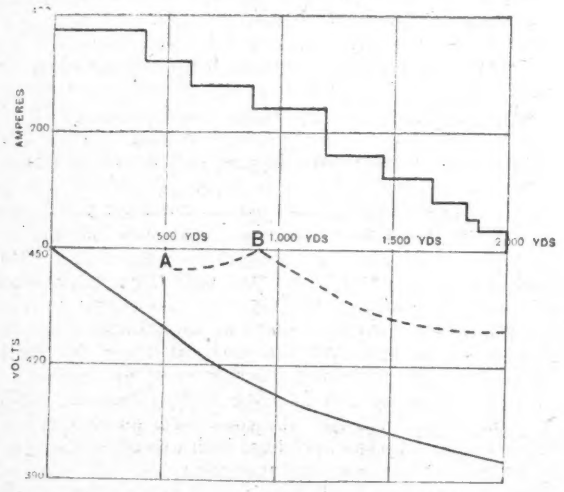


Fig. 3.

be at 850 yd. from the feeding point, see B in fig. 3. It is therefore necessary to raise the voltage at the point B to 450, which can only be done by means of boosting. A boosting sub-station should be placed at the point A, and from this sub-station a feeder run through a pair of boosters to the point B, the sub-station switches would be so arranged that when the boosters are switched in, the distributors are open circuited at this point, so that all the distributor above the point A is fed through the boosters, which could be made to switch in and work automatically, and to be self-regulating, or could be started up and shut down by hand. The size of the feeder in this case would be ·3, ·3 sq. in. two-wire feeder, the additional load taken by the booster motor at A would be very small, and it would not be necessary to make any allowance for this. The voltage curve when the boosters are running will be as shown by the dotted line in fig. 3.

With regard to the feeding points, it is often found that when the voltages get uneven, an additional feeder is run from the works to some point in the town, in spite of the fact that the load on the feeders is about one-third the carrying capacity of the existing feeders. The effect of this is that the voltages in that neighbourhood may be improved, but the general voltage of the system still remains in the same condition. The author's suggestion for this is that instead of a main feeder being run from the works, several back feeders should be run from the ends of the existing feeders, as by this means the voltage drop can be brought into reasonable limits, for the load conditions are known, also the distributors are fed in a number of different positions, thus relieving them of excessive load in the vicinity of the feeding points.

NOTES ON THE POSITION IN SOUTH AMERICA.

Engineers, financiers, contractors and concession-seekers have, during the past few years, had an increasing appreciation of the wonderful scope that lay before them all in South America. Many are the cases where timely and soundly-devised ventures have been taken up and successfully carried to fruition by English, American and German representatives of these classes, upon whom manufacturing industries depend. To-day many such undertakings are rendering satisfactory service to the States in which they are situated, and yielding profit to those who, with conviction and sufficient backing, went to take advantage of opportunities that presented themselves.

Concession Seeking and Finding.

Sometimes concessions have been secured by residents and offered to those able to work them, in this or other manufacturing countries. In other cases, Englishmen on their travels have observed an opportunity which, whether they have been in search of it or not, they have promptly seized, and, with the co-operation of necessary interests at home, have carried to a successful issue. The enormous wealth that the United Kingdom has poured into that part of the world naturally helped to create conditions favourable to British concessionaires. Long before the position out there was sound, when there were those periods of internal conflict and unrest through which some of the States had to pass, British money was forthcoming by the million. During those years of revolutionary strife, when obligations toward this country looked to be in jeopardy, there was generally some strong man who came out from among the people, took the helm, and steered along a clear course leading on to the more settled state of things that has become increasingly satisfactory as the years have passed.

The nervousness that for a time existed regarding investments in South American securities, taken in conjunction with some unfortunate trading experiences in which British firms at home were sufferers, naturally left behind a bad effect, and in some cases, at any rate, engineering firms were exceedingly suspicious in their dealings. This sort of thing, whenever it occurs, is bound to hang as a heavy weight round the neck of industry and enterprise, preventing free expansion.

In most countries—it matters not what the nationality, or what may be the peculiar characteristics which we have come to attach to the people—there always were, and we suppose always will be, men on the look out for opportunities to take advantage of firms, in this or other exporting countries, who through insufficient touch or inexperience, or a too trustful disposition, are likely prey for their net. The opportunity for such prowlers, too, is naturally far better when there is the unrest and uncertainty which cannot be prevented when peoples are fighting their way up the hard mountain passes

leading to the higher, healthier atmosphere of civilisation levels. Our travellers who went out there in search of business twenty or thirty years ago found little difficulty in securing orders; yet while we had not much to fear in the way of competition from other European manufacturing countries, terms of payment had to be most carefully settled, and drafts at 90 days had to be accepted; occasionally, too, the traveller's correspondence ceased, he being either "lost, stolen, or strayed, or otherwise conveyed," to be never heard of more. To-day things are altered greatly for the better in some respects, but foreign competition has made them worse in others, for we are, in South America, as elsewhere, faced with the longer credit system of Germany. Only recently in respect of Rosario, a Consul reported that we were losing our hold upon that second great centre of Argentina for this very reason. The American has less serious regard for export trade, and he fails because he insists on having cash down on the counter. English traders, as a rule, it is said, allow 30 to 60 days—we know, for a fact, it is occasionally 90 days. The Germans are said to have no hesitation in allowing 90 days—indeed, it is as though they had taken our best terms, and if we increased the period to 120 they would probably do the same. It is, however, very important that our firms should see whether, by making a general rule of their former exception, they can strengthen their hold upon not only Rosario, but all parts of South America. It does not appear to be competition as to quality of manufacture, or actual price quoted per machine or per gross of articles—it is rather the giving of the longest credit that is the deciding factor in much of the business that is being done abroad. Longer credit, however, of course, means less profit, unless you can secure a higher price for the accommodation.

Longer Credit—the German Weapon.

The risks attending an extensive foreign trade connection are, in the nature of the case, larger than those of the general run of Home trade, but we shall be acting short-sightedly if we allow ourselves to be so overwhelmed with the chance that we may be here and there taken advantage of, that we fail to appreciate the enormous possibilities of gain from the public authorities and sound business firms who are anxious for our co-operation as suppliers. The risks to-day are nothing compared to what they used to be in South America. If in those days it paid City of London engineering firms—as we know it did—to work these States by a well-equipped and linguistically accomplished traveller sent out from these shores, when the surface of the soil, so to speak, had hardly been scratched, and when the general conditions were, broadly speaking, unsatisfactory for trade, how much better should be the chances for engineering and electrical work there in these years, which are so full of such sure signs of a remarkable rate of general development now that the sword is in its scabbard (save for the recent little stir-up in Uruguay), and the utilisation of natural resources comes as the corollary of peace.

The Sounder Position of To-Day.

Probably some of the leading manufacturers and electrical engineering and contracting firms of the United Kingdom know as well as we can tell them what is the present state of things in South America, because they have already sent responsible officers to study it for themselves, but we are not so sure that others among them, and the lesser lights as well as the general reader, have had equally good opportunities for considering what is taking place, and what promises to come from the forces that are now at work, assuming a continued state of rest. British firms have not got the ground to themselves now, as we have already said. Indeed, South America is to-day, and has been for the past year or two a happy hunting ground for large numbers of German travellers, concession-hunters, and financiers, who have been sent out there in search of work to keep Continental manufactories in a state of continuous expansion. In reviewing this phase of the situation, our Rosario Consul, Mr. Hugh M. Mallet, in a recent report showed that foreign competitors are gradually increasing their trade in certain branches, and the number of foreign travelling agents constantly visiting those parts is noticeable, while their efforts, with a careful study of requirements and methods of trade, assist them to obtain large and profitable orders. He added that "competition for trade is very keen, and agents and travellers from abroad are constantly on the watch to meet requirements, and merchants, on account of the less trouble it gives them, frequently avail themselves of these opportunities to replenish their stock. To obtain practicable and profitable results, it is necessary to get into direct touch with the local buyers."

Face-to-Face Business.

It is inevitable nowadays, that where there is great development proceeding there will be keener competition. In most of the countries of the world it was the British manufacturer or merchant who led the way, and by his success showed others the profitableness of such work. Our financial hold has stood us in good stead in the past as business-producing, but sometimes it is thought that it would be better if we put more of this money into direct industrial and concession development instead of finding the capital for the factories of other countries to do the work. An important feature of the situation in recent years has been the eagerness of Continental firms to adopt financial measures necessary to get hold of concessions in which we are shareholders, with an eye to the industrial work that will follow upon such action and control. We have shown this over and over again in the columns of the Electrical Review. Little better evidence is needed of the Continental appreciation of what financial hold means in the matter of direct trade results, irrespective of investment interest return, than the steps taken by Continental syndicates to secure British-owned companies operating electrical undertakings in certain parts of South America. In some cases tempting offers have been closed with, and while, from a shareholder's point of view, the British gain may be immediate and substantial to those who promoted and invested in these companies, we should prefer to know that British electrical manufacturing is going to be benefited, and the big prospective profits on electricity supply, tramways, and the electrical requirements that attend on these in perpetuity—their "life" is very different from what we are accustomed to in England—as they develop will probably find their way into other hands than ours. It may even be—who knows?—that London, as the world's financial hub, will be asked to find the 4 or 5 per cent. investment which will be expended by these companies to which we have sold the concessions, in German works on German plant. Has it not happened so already?

Selling for Immediate Gain.

Mr. Mallet comments as follows on this aspect of the position in Rosario: "Formerly British capital alone monopolised the construction of public works, such as railways, ports, tramways, telephones and electric lighting. At the present time, however, foreign capital, chiefly French, German and Belgian, is competing for such works, and has been successful in securing several profitable concessions hitherto worked with British capital. For instance, the valuable concession (a monopoly) held by a British company for providing electric light, &c., to the city of Rosario, is about to pass into foreign hands. It is not a favourable sign for British interests, and must affect our trade with this part of the country, inasmuch as the material annually imported for the upkeep of these large establishments is likely to be purchased from foreign markets instead of from our own as hitherto."

A Map of South America.

Should the reader be sufficiently interested he might, after perusing these rough notes, make a fairly close study of a map of South America, just for the purposes of his business education. With the aid of available sources of information let him mark in the towns that he knows to already possess electrical works, tramway systems, hydro-electric and other power undertakings, like some enterprising spirits used to do years ago when we were dotting lighting and tramway undertakings here and there in the United Kingdom in search of any desirable spot that remained untouched. A close examination of such maps is an interesting study as a preliminary step in a case like this, though, of course, it does not convey a great deal. Literature telling of industries, populations, railway routes, climates, also relating to facilities already in existence must be fully studied, and there is plenty of it for those who want it.

"It's your Money we Want."

An aspect of the question that we do well to bear in mind right away is this, that the authorities of these South American States are on the look out for us, ready to receive with open arms those who have money to lend to help them to take full advantage of the natural wealth which Nature has poured into their lap with a most prodigal hand. They need our assistance as a wealthy people; they have lands and resources to develop. Our home market and home opportunities are necessarily restricted, we have engineers and men of business enough and to spare whose fingers are itching to be at work there; we have increasing need of the trade that everywhere paces arm in arm with development. They have of late shown a disposition to spend a good deal of money purely to advertise themselves amongst us, and let us know that they were well worthy of our support. Are we going to allow the very weapon that we have used in the past to be taken from our hands by Continental industrial banks and electrical-financial syndicates, which enable our foreign competitors to get in where our own banks fear to tread?

A Book on Brazil.

Our attention has been of late again drawn to Brazil by several documents that have been sent to us. A volume of close upon 400 pages* has been issued, under official orders, in the English language, relating to the industries of the country. It is the first of a series of volumes, and contains abundant matter prepared by a number of qualified collaborators with a view to giving a correct idea of the state of the country and its productive industries. The later volumes will include studies relating to agricultural, transport, and manufacturing industries. No one can peruse this first volume, studying the stages through which the country has passed in its history down to date, without having a new interest aroused in all that relates to it, or without being impressed by the wonderful natural endowments of its territories, and the great possibilities that lie before it now that it is peaceably settled down to the work of development. The Government authorities, and, indeed, the people of Brazil as a whole, are, in the words of the preparatory notice, "anxious to make Brazil widely known, in order that it may be rated at its exact value, and receive the co-operation of foreign capital and assistance," which, it is added, "are indispensable to its economical development." Of the details in the book we cannot stay to speak fully, but it is, "above all, a collection of statistical notes and information and a book of consultation." The history and geography of Brazil, the rights and privileges granted to foreigners under its laws, notes on population, fluctuation of immigration, international commerce, high sea navigation and Brazilian finance—all these are covered. A word should be stated in praise of Dr. L. R. Vieira Souto, First Vice-President of the "Centro Industrial do Brazil," under whose direction the work has been arranged. He has had the help of the members of the Committee of that Association, which undertook the preparation of the work under orders received in 1905 from His Excellency Dr. Lauro Müller, at that time Minister of Industry.

We hope, with the collaborators, that one result of the publication will be the elimination of errors and "rectifying incomplete notions formed all over the world with regard to Brazil," and that "it will give an exact idea of the wealth of Brazil's natural resources, and prove that the Brazilian nation possesses, among other qualities, the love of labour and the spirit of progress."

Two-thirds of the volume deal with the general matters named above, the remainder covering—in three sections—the vegetable, animal, and mineral kingdoms. Many reproductions from old engravings and paintings of events of special significance in connection with the progress of the country give it a quite live interest, and by the aid of the camera up-to-date views are given. A study of all such things brings one into more intimate touch with any land with which one desires closer industrial and trade association, so we have no hesitation in recommending a study of the book by electrical and engineering readers, as well as by investors.

(To be continued.)

* "Brazil: Its Natural Riches and Industries." Vol. I. Foreign edition. Paris: Librairie Aillaud & Cie. 1910.

ELECTRIC PREPAYMENT METERS.

By A. T. BULLEN and H. E. GOODY.

THE method of charging for electricity by slot meters is essentially unfair to the consumer; and although, of course, it has many substantial advantages over the quarterly account system, it must be admitted that these do not by any means offset the very serious defect indicated. It comes to this:—The better customer you are to the supply company, the more you have to pay for the privilege of having a slot meter. To take an example, in one London suburb the ordinary charge for lighting is 3½d. per unit; if a slot meter is installed the charge is increased to 4d. The slot consumer in this neighbourhood who uses 100 units a year, pays 4s. 2d. during this period for his meter; the consumer who uses 400 units a year pays just four times that amount —*i.e.*, 16s. 8d.

It is difficult to conceive of any method of prepayment which, while making allowance for the expenses of collection and the higher cost of the meters, would not penalise the good customer by making the charge for these extras vary directly as his current consumption.

Difficult as the problem is, the writers are of the opinion that its solution would be distinctly worth while, even from the supply company's point of view.

After the fundamental wrong, a little attention may be given to surface faults. The fact that slot meters cut off the electric light without any sort of warning has prevented a more extended use being made of them by the wealthier classes who value these little mechanical refinements. To remedy this defect, an electric bell which rung just before the meter switched out, has been tried, but apparently without success. A better method seems to be the introduction into the circuit of a resistance or inductance (according as the supply is D.C. or A.C.), so that at an arranged time before switching out, the light shall be dimmed. Two objections to this method are, firstly, the complications introduced into the meter by the necessity for a second switch to short-circuit the resistance or inductance during the ordinary working of the meter; and, secondly, the fact that the effect of such resistance or inductance on the light would vary according to the number of lamps in circuit; and delicate adjustment would be required to ensure that the light reduction would not in some cases be almost unnoticeable, and in others inconveniently great. It ought not to be impossible to surmount these obstacles, but in any case the addition to slot meters of a warning device of this kind would be a tremendous improvement, and should help to increase their popularity.

The mechanical faults of electric slot meters are being removed one by one, and the most recent types are certainly as accurate and reliable as gas slot meters.

The bad old times of a few years ago, when the meters were so generally inaccurate that collectors in sheer desperation used just to take whatever money was in the coin chamber without asking any questions, or even troubling to check the amount by what was the only reliable part of the meter, namely, the dial indication, are gone beyond recall.

A friend of the writers' used a prepayment meter for two years, and not for a single week during the whole of this period did it work correctly. It would not switch out when the prepaid amount had been consumed. He complained to the company, and they repaired it thrice; but after each repair it fell again into the same evil ways. Finally, the company changed the meter. The new meter suffered in precisely the same way; but the consumer was too disgusted to make another complaint. He knew about when the collector would come, and each quarter just before the visit 4s. or 5s. were put into the meter. The collector took the money and raised no questions as to the correctness of the amount. This went on for considerably more than a year,

and the consumer must have used quite three times as much current as he paid for. It cannot be supposed that the collector was entirely ignorant of the fact that the meter was wrong, but he took the only course possible in the circumstances.

In spite of improvements, one fairly recent meter still has a painful and irritating habit of switching out if it is subjected to a slight jar, such as may be caused by the violent shutting of a door. A supply company which has about 300 of these meters installed has decided to scrap the whole lot as opportunity occurs, and chiefly for the reason indicated.

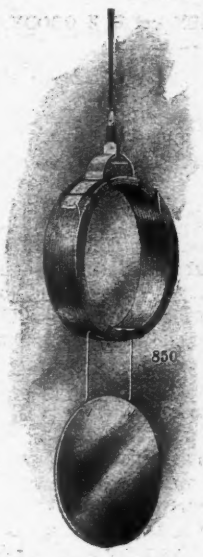


FIG. 6.—COIL AND MIRROR OF CROMPTON GALVANOMETER.

Penny slot meters are quickly becoming obsolete; but in their time they have been the cause of much annoyance to supply companies and consumers. The coin chambers of these meters used, as a rule, to be open at the top, and it was not at all an uncommon occurrence for pennies to overflow into the body of the meter or to get jammed in the switch. They were also very difficult to collect from, as the trap of the coin chamber was usually underneath the meter. To take 15s. in coppers from a meter of this description without dropping a penny was considered quite a feat.

The fact of the matter is that slot-meter manufacturers have not given sufficient attention to the small constructional details of their work. They were in too much of a hurry to place on the market a cheap meter before learning how to make a reliable one.

An ordinary meter may be made very flimsily and roughly, but with a little luck it will work well for years. A badly made slot meter will not work for a week, no matter how good the design may be theoretically, and the fact cannot be blinked that the earlier types of slot meters were put together disgracefully.

The latest pattern of Siemens shilling slot meter is fairly typical of up-to-date practice. It registers the number of units consumed, the number of unused coins in the meter, and also the total number of coins which have been inserted. The coin chamber is removable, so that collection is facilitated and money is not so likely to be dropped. Even in this excellent meter there is, however, a small, but very irritating defect—irritating because so unnecessary. The removable coin chambers do not fit well, and in consequence they frequently jam when pushed in or pulled out. This, of course, is a detail, and it may seem hypercritical to mention it, but it is the writers' experience that meters and kindred apparatus fail to attain success more often for trivial reasons such as this, than because of any fundamental error in design.

When perfection in design and construction is attained, it will remain only for supply authorities to devise some system of charging less unfair than the present one, before the slot meter becomes almost universally popular.

THE PHYSICAL SOCIETY'S EXHIBITION.

(*Continued from Vol. 67, page 1058.*)

MESSRS. CROMPTON & CO., LTD.

THE well-known standard Crompton potentiometer—an instrument originally developed into a commercial form by this firm—in its latest pattern formed a prominent feature of the exhibit, together with the bifilar galvanometer which is equally associated with the name of Crompton. The moving coil employed in the latter is illustrated herewith (fig. 6), to show the ingenious method adopted for clipping the coil on to the double suspension, making the connections at the same time. The large mirror is attached with equal ease, being simply hooked on a pair of stirrups below the coil. Devices in the head of the instrument enable the sensitivity to be varied over a wide range, and the zero to be adjusted with facility.

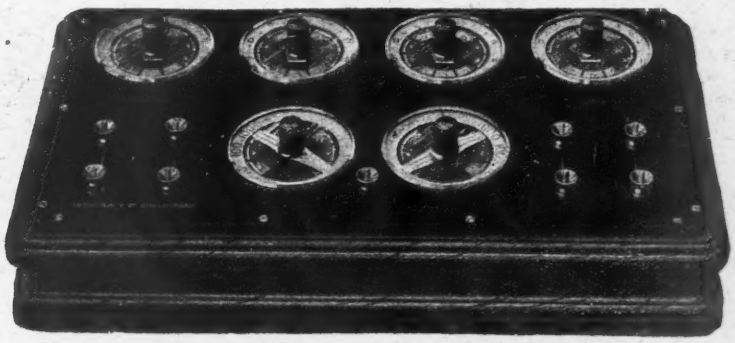


FIG. 7.—WHEATSTONE BRIDGE.

Fig. 7 shows a new type of Wheatstone bridge recently introduced by the firm, in which the contacts are enclosed under plate-glass covers, easily removed, but absolutely dust-tight when in place. The contacts are faced with silver, and are practically invariable. The dial arrangement enables balance to be effected and readings to be taken with the least possible loss of time. The remaining figure represents one of Messrs. Crompton's latest moving-coil ammeters for workshop or switchboard use, in cast-iron case. Besides these, a variety of ammeters and voltmeters, pyrometers, &c., were exhibited.

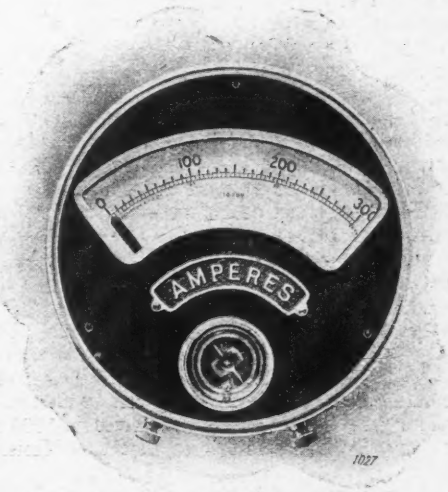


FIG. 8.—CROMPTON MOVING-COIL AMMETER.

MESSRS. EVERETT, EDGCUMBE & CO., LTD.

Several novelties were shown by this firm, besides a number of improved patterns of their well-known instruments. Perhaps the most noteworthy feature was a neat little "pocket" Luxometer, for measuring candle-power and illumination. This instrument, which measures only 7 in. × 3½ in. × 2 in., and weighs less than 1 lb., is the outcome of a number of years' experience with various forms of portable and other photometers. It consists of a self-contained standardised lamp, which throws a beam of light on to an inclined screen, as in the Trotter standard portable photometer. A mirror from the central portion of which the silvering has been removed is viewed through an eye-piece, and is set at such an angle that it reflects into the eye-piece the inclined screen above-mentioned. The eye, therefore, sees in the field of view a small annular patch representing the inclined screen and a central

portion which is cut away. Through this central portion the object, the illumination of which is to be determined, is viewed. The angle made by the inclined screen with the rays of light is variable by means of a milled head, and is adjusted until the illumination of the central and outer parts of the field of view coincide, on the well-known Trotter principle. The illumination of the object viewed can then be read off on a direct-reading scale, graduated usually from 0 to 4 ft.-candles.

When it is wished to determine the intrinsic brilliancy of a surface the above procedure is followed, and the same can be done by viewing a surface placed horizontally, if the horizontal illumination at any point is required. For the sake of simplicity and compactness, however, a transparent opal screen is provided with the instrument and is placed just over the central portion of the mirror alluded to above. This opal screen receives the illumination to be measured, and in this way the measurements of the illumination on the screen at any required angle can be at once read off on the scale, or by multiplying by the square of the distance between a lamp and the photometer, the candle-power of the lamp can be determined. The instrument is so arranged that a new internal lamp can be at any time substituted without disturbing the calibration in any way, and that the calibration can be corrected at any time against an external standard lamp.

FIG. 9.—POCKET LUXOMETER IN USE.

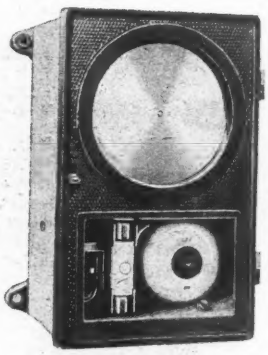


FIG. 10.—TROLLEY STANDARD LEAKAGE INDICATOR.

FIG. 11.—E.H.T. ELECTROSTATIC VOLTMETER WORKING THROUGH CONDENSERS.

EVERETT, EDGCUMBE INSTRUMENTS.

For many purposes, particularly for the use of architects, surveyors, medical officers, &c., it is important to be able to determine, not only the illumination in foot-candles of a certain room lighted by daylight, but also a figure expressing the illumination of the room independently of whether the day on which the test is made is a bright day or a dull day. For this purpose, the daylight attachment devised by Mr. Trotter, and subsequently developed by Mr. Waldron, has been adopted, so that altogether the Luxometer is capable of carrying out photometric measurements of every kind.

A trolley standard leakage indicator, devised by Mr. A. H. Pott, of the North Metropolitan Tramways Co., has been introduced to meet the Board of Trade requirements as regards an audible signal for at once detecting a contact between the cable leading the current from the trolley-wheel to the car motor and the standard fixed to the top deck and carrying the boom. In the past various devices have been employed, such as red lamps, &c., but they labour under the serious disadvantage that should they become deranged there is no means of detecting the fact. Mr. Pott's arrangement entirely overcomes this objection. It consists of a self-contained fuse and a high-voltage buzzer, which can be connected direct to the 500-volt system. When a leakage takes place, making the standard alive, the fuse is blown and the buzzer immediately sounds, compelling attention to the matter. The conductor then clears the upper deck, and afterwards breaks a mica window, which enables him to switch off the buzzer, the broken window, however, serving as a record of the fact, so that the car must not be brought out of the depôt again without rectifying the fault. An arrangement is provided to enable the condition of the apparatus to be tested at any time.

Fig. 11 shows an electrostatic voltmeter working through condensers, which, on A.C. circuits, do not interfere with the indications of the instrument, but effectively insulate the latter from the high-pressure mains, and prevent all possibility of a serious shock to the user. The condensers may be separate as shown, or may be attached directly to the main terminals of the instrument. Voltmeters operated in this way are particularly suitable for use as leakage indicators, &c.

An improved rotary synchroniser, and a new central-zero A.C. voltmeter for use in conjunction with it when paralleling, were also shown, and will be referred to later.

MESSRS. NALDER BROS. & THOMPSON, LTD.

The principal instruments shown by this firm, in addition to a number of their standard testing sets, switchboard instruments, &c., were portable standard ammeters, voltmeters and wattmeters, of the dynamometer type, suitable for use with either D.C. or A.C., and equally accurate in either case. The temperature and frequency errors of the wattmeters and voltmeters are quite negligible, and in the ammeters have been reduced to a very small amount; the voltmeters are guaranteed to read within ¼ of 1 per cent., and the ammeters and wattmeters to within ½ per cent. Fig. 12 shows a portable wattmeter of this type.

A standard dynamometer wattmeter of 50 KW. capacity was exhibited, in which the whole of the current (up to 300 amperes) was taken through the instrument, thus avoiding the necessity of using a large and expensive shunt, and doing away with temperature and frequency errors.

MARCONI'S WIRELESS TELEGRAPH CO., LTD.

The apparatus exhibited by the Marconi Co. consisted of a standard valve receiver of the latest model, comprising valves, tuning circuits, valve battery and battery charging arrangements;

FIG. 12.—NALDER PORTABLE STANDARD WATTMETER.

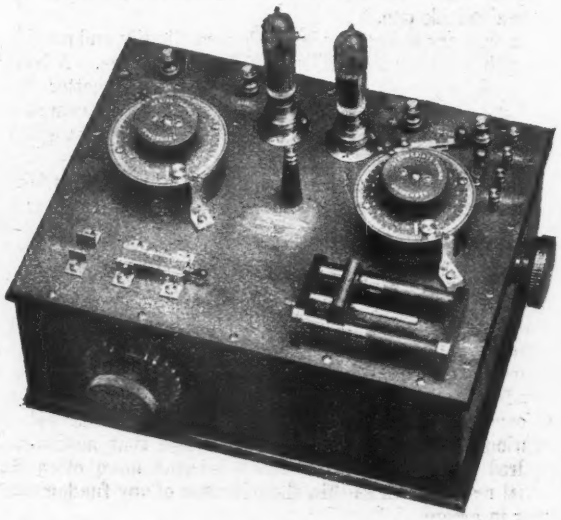


FIG. 13.—MARCONI VALVE RECEIVER.

for the purpose of showing its working a buzzer was also on view. This latest type of valve receiver was specially devised for use on

board ship, where the rules of the International Radio-Telegraph Convention require working to be carried on with waves principally between 300 and 600 metres, and where bulky apparatus and high-voltage valves, high-resistance leaks and other features of the earlier types are inconvenient.

The receiver in question, which is shown in fig. 13, is arranged to provide a "stand-by" circuit for the reception of waves of widely different wave length without change in the adjustment, and a switch for changing instantaneously from "stand-by" to "tune," with tuning arrangements for working on any wave between 250 and 750 metres, thus covering the range required by the above-mentioned Convention. The valve only requires 4 volts, and is operated by three cells, with a resistance in series for regulating the glow of the filament; a potentiometer resistance of comparatively low value takes the place of the high-resistance leak of the earlier type.

(*To be continued.*)

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Ironclad Switchgear in Printing Works.

The accompanying illustration shows an ironclad power switchboard which has recently been constructed by MESSRS. BERRY, SKINNER & CO., of 78, Upper Thames Street, E.C., at their Birmingham works. This type of board, it should be mentioned, was originally developed by Mr. Frank Broadbent, and has been largely used by him during the past year in connection with various important installations. The special features of the board are its safe and foolproof character, and the fact that it can be erected in any part of a factory without a special enclosure; moreover, no space is required behind the board, every part of which is completely accessible from the front. The whole of the equipment is of Messrs. Berry, Skinner's standard design, ironclad throughout, and the ironwork is earthed so that it is impossible to receive a shock from any part. The board has been installed, to the specifications of Messrs. T. L. Miller, Wilson & Pegg, by Messrs. John Dowling & Sons,

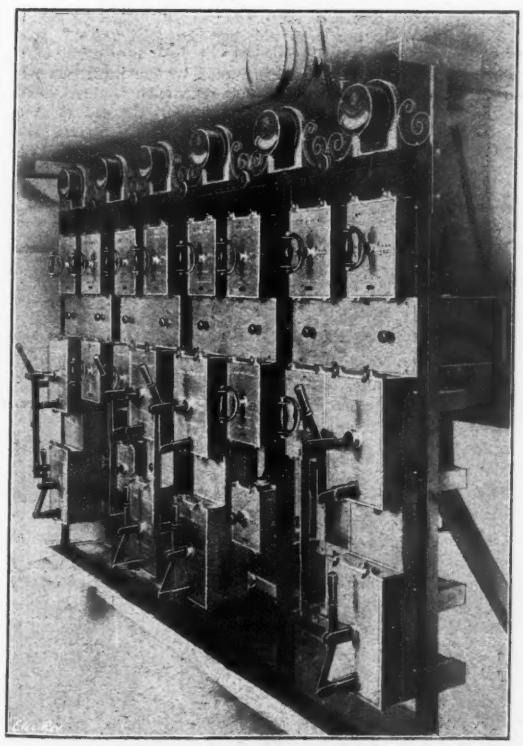


FIG. 1.—BERRY, SKINNER IRONCLAD SWITCHGEAR.

in the premises of the *Belfast Evening Telegraph*, with which is incorporated the extensive printing works of Messrs. W. and G. Baird, Ltd, in connection with a rearrangement of the electrical equipment, designed to ensure immunity from breakdown and to arrange for a proper subdivision of electrical energy to the various departments.

The entire works are electrically driven throughout, the present total motor load amounting to approximately 400 H.P.; extensive additions are, however, being carried out, and the revised installation provides for a load of 650 H.P. Arrangements have been made with the Corporation for two separate supplies, which will be connected to change-over switches on the main section boards, these boards controlling the various distribution boards in the different departments of the building. The main section boards are fitted throughout with ironclad foolproof interlocking change-over switches, which are so arranged that under normal conditions half the load, as regards both the 440-volt service and the two sides of the 220-volt service, is carried on each of the above-named Corporation services. In the event of any failure of supply from either area, the entire load can be thrown on to the remaining supply. In connection with the two Corporation services totalising ammeters are fitted, so that the load carried by either service can be seen at a glance, the distribution of the load on the positive and negative sides of the 220-volt service being also indicated. The special arrangement of the duplicate change-over switches on each board not only enables the load to be evenly divided as between the two areas of supply, but also makes it possible to control accurately the division of the load between the two sides of the 220-volt service, the change-over of the positive or the negative load from one service to the other being a matter of a few seconds only.

Portable Frequency Indicator.

MESSRS. SIEMENS BROS. & CO., LTD., of Caxton House, Westminster, have recently introduced a new pattern of the Frahm frequency indicator, arranged for use as a portable instrument. The appearance of the indicator is shown in the accompanying figure, which represents a meter reading from 40 to 55 cycles per second, in steps of half a period; for frequencies above 80, the steps are one period each, and below 30 cycles, ¼ period each. The instrument is suitable for all pressures from 50 to 300 volts, being

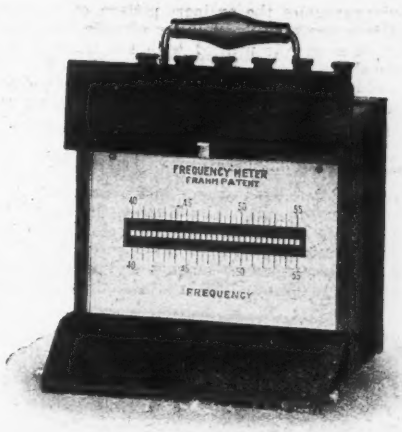


FIG. 2.—SIEMENS PORTABLE FREQUENCY INDICATOR.

provided with terminals for five pressures between these limits, and is fitted with an adjusting screw to enable the full amplitude of vibration to be obtained at intermediate pressures; it can also be adapted to higher pressures.

By providing two electromagnets, one of which is polarised, to vibrate the bridge-piece which carries the reeds, it is possible to double the range of the instrument, for the ordinary magnet attracts the armature twice in each cycle, while the polarised magnet acts only once per cycle. The change-over is effected by means of a commutator. Two series of reeds may also be fitted in one instrument, thus giving, with the aid of the doubling device, a total range from 10 to 80 cycles. The instrument is made in two sizes, with a large variety of ranges.

The New "Kalkos" Switch.

We recently described (September 30th, 1910) the new watertight tumbler switch of the SUN ELECTRICAL CO., of 118, Charing Cross Road, W.C., which is characterised by a simple but effective method of ensuring good contact in the jaws; this is effected by means of two small brass disks connected inside the block by a short piece of flexible copper cord, the disks being free to rotate (with the flexible), and thus to find their own bed on the clips. We have been shown three of these switches, made to carry five amperes, which have been subjected to very severe tests. One had been caused to make and break a current of five amperes at 200 volts 10,000 times; the faces of the contact disks were perfectly clean and bright, the only signs of wear from sparking being round the edges of the disk, where it could do no harm. Incidentally, the uniformity of the wear all round showed that the disks had gradually rotated, as they were meant to do. Another switch had made and broken three amperes at 200 volts 40,000 times, and was in equally good condition; while the third had been put on and off 40,000 times without current, and practically without effect on the parts. As few switches are called upon to act more than, say, 1,000 times a year, these tests appear to indicate that the switches would outlast the whole of the rest of an installation and still be hale and hearty. The same switches had also been exposed for prolonged periods to the effects of steam and damp surroundings without apparently suffering the slightest injury. They are specially adapted for use with the "Kalkos" adjustable boxes, &c.

Quartzalite Heaters.

The Bastian Electric Heating Syndicate, Ltd., of 91, Palmerston House, E.C., have introduced a new type of heating element which is separate from the vessel to be heated, so that it can be used in conjunction with a variety of utensils. As shown in fig. 3, it is flat in shape, and fits into a metal pocket in the vessel,

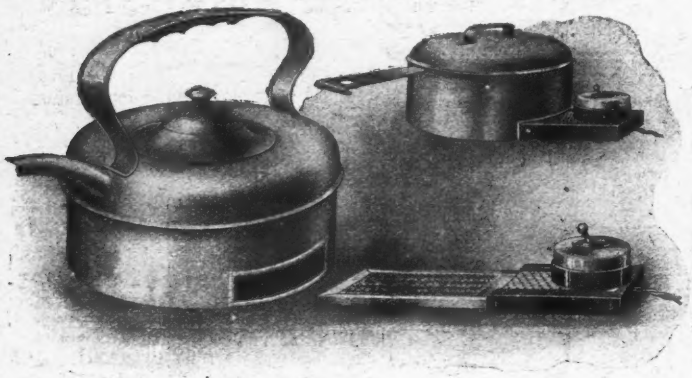


Fig. 3.—Quartzalite Heater and Utensils.

which otherwise resembles the ordinary pattern of cooking apparatus; indeed, it is easy to convert many utensils hitherto heated by gas, so that they can be utilised with the Quartzalite heater. The illustration shows a kettle and a saucepan thus fitted, as well as the heater, which is provided with a switch and flexible. The heater is at present made with a maximum capacity of 2 kw., and will boil two pints of water in a kettle in 12 to 15 minutes.

Lecture Demonstration Instruments.

A new and greatly improved type of instrument for use on the lecture table has been brought out by Messrs. Siemens Bros. and Co., Ltd., of Caxton House, London, S.W.; it is shown in the accompanying illustration, with an electromagnetic movement, and is also made with a permanent magnet and moving coil. The instrument has a large open dial facing the students, and a smaller

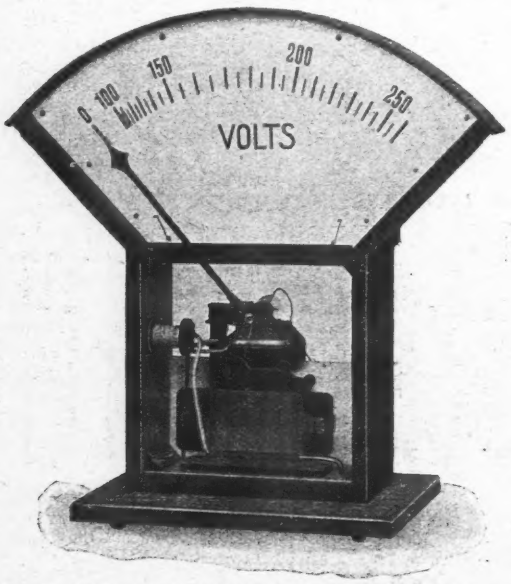


Fig. 4.—Siemens Demonstration Instrument, Type A.

one, more accurately marked, facing the lecturer—the latter scale enabling the instrument to be used also in the laboratory. The movement is enclosed in a glass case, showing the working parts.

These instruments are made for d.c. and a.c., and can be supplied also with the Ferraris a.c. movement; they can be had also with the zero in the centre of the scale, and thus can be utilised for a great variety of experiments and demonstrations.

Sterling "Primax" Inter-Communication Telephones.

The Sterling Telephone and Electric Co., Ltd., of 200, Upper Thames Street, E.C., have just introduced a new system of intercommunication telephones, called the "Primax" system of automatic interphones, which, while possessing the advantages of the ordinary system, with central battery, is free from the annoyance due to induced overhearing and cross-talk which is often experienced. It is not claimed that the system provides a secret-conversation service, but that cross-talk has been so far eliminated that it is now possible, in a system of, say, 30 Primax interphones, to carry on the maximum number of conversations simultaneously without confusion. To attain this result, only two additional common wires are required in the cable, and the instruments, which

Fig. 5.—Sterling "Primax" Automatic Interphone.

are externally similar to those previously supplied by the company, cost no more than formerly. All their battery-ringing automatic intercommunication telephones will in future be supplied arranged for working on the new system, unless otherwise specified. The accompanying illustration shows the "Primax" radial-switch automatic table-set.

New Fuse.

In connection with our notice of a new fuse, in the Electrical Review of December 23rd, 1910, the British Central Electrical Co., of 84, Hatton Garden, E.C., inform us that the design is provisionally protected.

"Flexalite" Electric Candle Fittings.

The Sun Electrical Co., Ltd., of 118 and 120, Charing Cross Road, London, W.C., are now placing the "Flexalite" patent electric candle fitting on the market. A full description of this fitting is contained in a new list just issued by the firm. The base of the fitting consists of a piece of porcelain with a steel-ribboned self-centring collar, which may be placed in the socket of any candlestick. Two tapering screws fit into the base, and by manipulating these a perfect fit can be obtained, no matter what irregularities there may be in the hole of the sconce, or how large

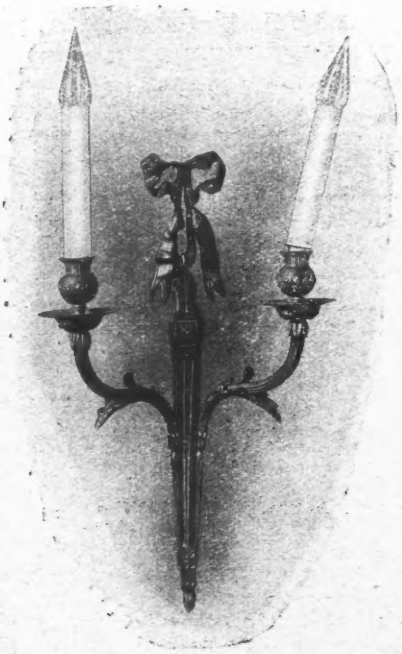


Fig. 6.—Flexalite Candle Fitting.

or small the size. The "Flexalite" candle fitting may be fitted in an absolutely vertical position, quite irrespective of any irregularities in the ornamentation on the top of the sconce.

On the porcelain base is attached an expanding spring connector, which connects the circuit to the terminals of the lamp. This

spring is so made that it is adaptable to any size of candle from 3 in. to 8 in. long. After the porcelain base is fixed in the sconce, and the candle placed in position, the expanding spring is pulled up through the tube of the candle and fixed to the top by one of three hooks at the end of the spring. The metal-filament lamp itself is provided with two eyes corresponding with the

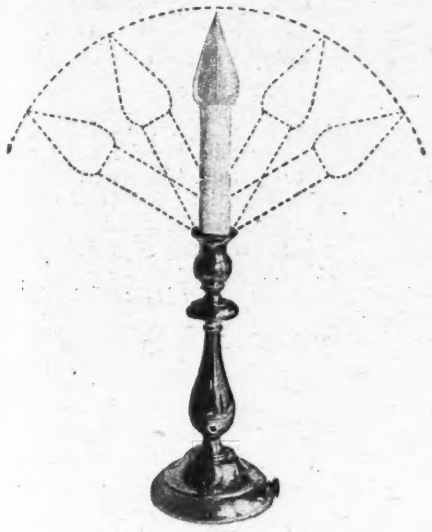


Fig. 7.—Flexibility of "Flexalite."

hooks on the spring, and when these are joined the connection is complete.

Although the base is rigid in the sconce, the tube of the candle is held erect by the expanding spring in its interior.

In fig. 6 the "Flexalite" fitting is so shown as to illustrate the action of the spring connector, and in fig. 7 the dotted lines indicate the action of the spring in bringing the candle back to the vertical position if by any cause it is knocked aside, in dusting or so forth.

THE THEORY AND PRACTICE OF WIRELESS DETECTORS AS AT PRESENT USED.

By S. M. POWELL.

The early coherer type of wireless detector (invented by Branly) marked a great advance on the crude inflexible "oscillator" of Herz, but was, and is, subject to the great disadvantage that it is not self-decohering, and, moreover, unless very carefully constructed, is liable to rapid ageing and loss of sensitivity. The magnetic receiver introduced by Marconi has many excellent properties. Though the telephone sounds obtainable by the use of this detector are weak, they persist at very long distances of transmission, so that this type is likely to perform much useful work in long-distance "wireless" for some time to come. It is with other types of detector, however, that the present article deals, space being specially devoted to several of the newer types of receiver and to certain of the older ones recently improved, or over whose mode of action discussion still prevails.

Considering first the desiderata of a satisfactory "wireless" detector, automatic decoherence is usually very desirable; low detector resistance minimises the damping of the receiving circuit, and so enables sharper resonance and great freedom from interruption by other signals than those desired. The detector must, while possessing maximum sensibility to the waves to be received, be influenced as little as possible by any other cause (*e.g.*, by vibration, stray magnetic or electrostatic fields, &c.). Freedom from interruption by "atmospherics" must usually be attained by suitable syntonic connections in the receiving circuit, so as to prevent response to any disturbances but those of the correct wave length. Other requirements, of the greatest importance as regards the commercial adoption of a detector, are simplicity, ease of construction and repair, and easily obtainable and safely handled materials. Reasonable mechanical strength is a minor requirement, all operators handling the apparatus being necessarily skilled.

Wireless telephony makes rather more stringent demands than wireless telegraphy as regards detectors. In the first place, wireless telephony essentially employs continuous trains of waves, which necessitates the use of a "ticker" with many forms of detectors. Otherwise only a steady attraction of the telephone diaphragm is obtained and hence no audible signal. The "ticker" consists essentially of an electric bell magnet system, the hammer being removed and a contact tongue put in its place. This chops up the received continuous train of waves, and enables them to be read in the telephone. Some forms of detector, *e.g.*, the electrolytic, do not require a ticker. Since continuous reception is essential in wireless telephony, the detector must be self-decohering and quick acting. To enable the fluctuations in the received waves to be appreciated the detector should be of the quantitative type (see below); its operation must be quite smooth and its note pure, otherwise speech fluctuations imposed on it will be heard very imperfectly. Resonance in the receiving circuit, by introducing a time element during which the tuned circuit "builds up" resonance, results in a smoothing effect on the telephone currents and prevents reception of all the fluctuations of the emitted waves. Thus it is that resonance produces distortion in wireless telephony, and is to be avoided. A quick acting detector in a circuit in which forced oscillations are produced gives maximum clearness of reception, though the arrangement is disadvantageous in other respects, and is to be avoided in wireless telegraphy, and in any case where maximum privacy is desired. The "coherer" is not suitable for telephonic purposes, but electrolytic, thermo-electric, magnetic and rectifying detectors may be used successfully.

Methods of Testing Detectors.—The testing of detectors is a matter of some difficulty, and opinions as to the most generally useful form of receiver cannot yet be advanced with any degree of certainty for this reason. Testing a detector in a laboratory by means of a local transmitting and receiving equipment cannot approximate to the actual conditions of practice. The whole scale of the equipment is utterly different; the currents and pressures dealt with are not the same, and the relative importance of resistance, &c., is altered. Too often transmission takes place purely by magnetic induction, and results so obtained cannot accurately indicate the value of a detector which is to be used in a circuit affected by electrostatic induction. Laboratory test distances between transmitter and receiver can seldom exceed 50 to 100 ft., and, over such distances, direct magnetic induction may well prove more operative than electrostatically induced oscillations translated by the detector under test.

Two methods of testing may be briefly referred to, (1) by Fleming, (2) by Jégon.

1. *Fleming's Method.*—Full details of this method are to be found in the *Phil. Mag.* 17, pp. 670 to 676. Essentially, a very steady train of oscillations is produced in a closed circuit, and received by a second closed inductor coupled to the detector under test. The receiving inductor is rotated till the sound of the signals just vanishes in the receiving telephone; the angular displacement of the coil from the position of maximum reception is then noted on a scale provided, and forms a measure of the detector's sensibility.

2. *Jégon's Method.*—In this method a microphone transformer is employed in the receiving circuit. The secondary is connected across the points usually connected to the telephone, the latter being now connected to the primary of the coil. The secondary and core of the transformer are fixed, while the primary is moved laterally till the signals (of constant transmitted strength) just become inaudible. The position of the primary coil, as read on a scale provided for the purpose, then forms a measure of the detector's sensitivity. The secondary winding has about 150 ohms resistance, that of the primary being about 1 ohm.

Both the above methods labour under the same disadvantages, apart from the difficulty of ensuring a constant train of

waves and the fact that laboratory adjustments can never be those of practice :—

1. Different types of detector work best under different conditions of receiving circuit, particularly as regards telephone resistance (magnetic detectors favour a lower telephone resistance than do the electrolytic type).

2. The resistance of detectors themselves varies (see Table II) introducing yet another variable, while the exact performance of a given detector varies from time to time, being temporarily specially favourable or unfavourable, as the case may be. The writer has found detectors to vary considerably from day to day in this respect, particularly those of the thermo-electric and rectifying types. The exact nature of the point contact is of the utmost importance, and only long experience with detectors in practice can determine the type best suited to the range and general conditions, electrical and otherwise, of the station in which they are used.

Connection of Detectors.—Of the various systems of connecting detectors, space prevents full treatment, nor would such a discussion be within the scope of the present article. One point is, however, relevant, viz., the effect of using detectors in series or parallel. Jégon has investigated this matter with his testing circuit already referred to. He finds that the sensibility obtained by the use of two detectors in series, with the normal terminal P.D. maintained across each

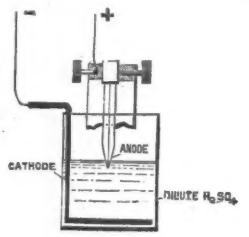


FIG. 1.

detector, is less than that of the less sensitive of the two used alone. On using the detectors in parallel, however, the combined sensibility is at least equal to that of the more sensitive one used alone, and may be higher, while a valuable increase in the reliability of the equipment is simultaneously secured, since one of the two paralleled detectors usually survives any burn-out of the other and enables continuous working.

With regard to the general connections of detectors, it may be remarked that two main divisions are to be discriminated—(*a*) The connections used for detectors depending on an applied terminal potential difference for their operation ; (*b*) those used for current-operated detectors.

The "coherer" has been repeatedly proved (notably by Erskine Murray) to depend solely on potential difference for its operation. Metal filings can be "cohered" as easily by a direct-current pressure as by a high-frequency alternating pressure. The electrolytic detector, however, depends essentially on a high-frequency current for its operation, and this would appear to support Eccles's theory concerning the action of this type rather than the more generally prevalent polarisation theory (both of which are referred to in detail below).

Imperfect contact detectors in general, in which the variations of the contact resistance produce the desired signals, such as electrolytic and thermo detectors of the crystal type, are current operated ; while the former depend on the maximum amplitude of the electrostatic field at the receiving station, the latter depends on the mean energy received. It is, however, possible to use thermo-electric detectors as potential detectors by connecting them in a P.D. loop instead of in a current loop of the receiving circuit. Coherers and similar detectors can never be current operated. Tissot has observed that a galvanometer connected across a thermo-electric detector, with the intervention of no local battery, deflects in exact proportion to the readings of a bolometer similarly exposed. This behaviour is quite different from that of auto-decohering contacts.

If the diagram of energy transmitted from a directive sending station be measured by a thermo-galvanometer, detectors depending on the total energy received (*e.g.*, thermo-electric sets) will give a precisely similar diagram, while those depending on maximum P.D. (*i.e.*, the amplitude of the received field) will give a diagram whose *radii vectores* $\propto$ the square root of the thermal detector diagram ordinates (Bellini and Tosi). To this class belong imperfect contacts. Frequently the diagram obtained is intermediate between the above two limiting types, and in such cases the detector depends partly on current and partly on P.D. operation, though usually with a very decided bias towards one or the other.

Types of Detectors.—The types here considered are : The imperfect contact, the electrolytic, the thermo-electric, the unilaterally conducting or solid rectifier, and the vacuum, "oscillation" valve or "audion" detectors. Considering the nature of each in turn, its principle of action, its advantages and disadvantages and the extent to which it satisfies the general requirements already stipulated, the following results are obtained.

1. *Muirhead's Improvement of the Imperfect Contact Type.*—A poor contact of the point and plane type (between metals) is placed at the bottom of an oil column. It is found that the sensitivity and auto-decohering characteristics of such a detector vary with the oil pressure, which may be varied either by means of a pump or by pivoting and rotating the containing tube so as to alter the effective head of oil. Increased sensibility is thus secured, and the necessity for an external decoherer is avoided : two of the chief disadvantages of the simple coherer are therefore obviated. Allowing oil to flow slowly past the loose contact is equally satisfactory. The oil used may be a heavy paraffin oil or glycerine, fairly high viscosity being apparently essential.

2. *Electrolytic Detectors.*—The commonest form of electrolytic detector consists of a platinum or gold cathode immersed in an electrolyte of dilute sulphuric acid and a platinum anode of special construction. An excellent method of preparing the latter consists in soldering a short length of Wollaston wire to a platinum lead and drawing the whole into a glass jet (fig. 1) till the Wollaston wire projects a millimetre or so from the jet. The latter is then clamped over a beaker containing strong nitric acid, so that the silver coating of the Wollaston wire is dissolved off for about 2 mm. The jet, after being washed and dried, is sealed off at the end. A brass cap is cemented to the open end, and subsequently used as the anode terminal (fig. 1), the platinum lead

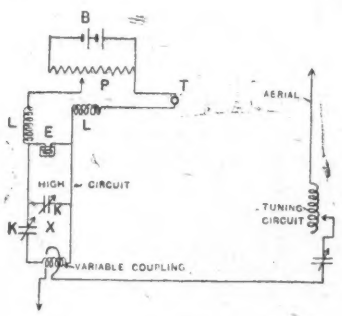


FIG. 2.

being soldered to it. The point of the jet is carefully ground on an oil stone till a section of the Wollaston wire is exposed, as indicated by electrical continuity from the brass cap to the electrolyte (tested by dry cell and galvanometer). This being secured, the detector is ready for use. The tip of the anode is immersed just below the surface of the electrolyte (fig. 1) and the effective anode area is merely that of a platinum disk $\frac{1}{1000}$ to $\frac{1}{100}$ mm. diameter. The depth to which the Wollaston wire projects into the electrolyte is immeasurably small. This type of construction if better than that of waxing a Wollaston wire except for about $\frac{1}{100}$ mm. at its tip, the latter being about $\frac{1}{1000}$ mm. diameter and upwards. The construction is more feasible and the finished anode more robust in the present case. The action of such a cell is usually taken to be one of polarisation.

A common method of connecting electrolytic detectors is as shown in fig. 2. The battery B acting through the potential divider P and the high frequency "blocks" L L polarises the fine platinum anode in E practically instantaneously. High-frequency aerial currents induce similar currents in the tuned circuit X, and these depolarise E, allowing B to send a momentary direct current through the telephone T ere the cell E is again polarised. The action being repeated again and again, a continuous buzz is heard in T so long as current flows in the aerial.

Eccles has recently advanced a rather different theory, and one which, as mentioned above, derives considerable justification from the dependence of the detector on current rather than on P.D. Eccles states the anode to be covered with a gaseous film about 0·0000005 in. thick, the diameter of the anode being possibly 0·001 in. More than half the heating effect of the current flowing is concentrated on an annulus of the film 0·0001 in. wide, of mass 4×10^{-10} gm. Such a film being heated 0·5° C. by 0·01 erg, and less energy sufficing to operate an electrolytic detector, it is quite possible that heating is the cause of the phenomenon.

Abraham, again, advances a theory regarding electrolytic detectors, making the action a condenser effect. Since electrolytic detectors at normal temperatures have a capacity of some hundredths of a microfarad (associated with a resistance of several thousands of ohms), it is quite possible that the detector cell is discharged by the oscillatory signal currents, and recharged by the local battery, the latter charging current being that which produces the signals.

Probably the actual action is partly due to each of the three causes—polarisation, heating and condenser action. The magnetic detector, and possibly the "oscillation valve," are the only known types of detector that can claim dependence on one phenomenon only for their action.

(To be continued.)

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Turning Down Incandescent Lamps.

At the present time there is a big scheme of advertising on foot relating to a regulating switch for incandescent electric lamps. According to the circulars the said regulating switch is something phenomenal, but on examination I find it is simply a neat design embodying the old and wasteful method of putting resistances in circuit with the lamps. The circular says: "You turn up your electric light and you turn it down just like gas," and a summary of advantages is set out. The advertisement includes a Faraday House certificate of a test on one of the switches, but this certificate carefully avoids all reference to the very heavy current consumption per C.P. due to the energy taken by the resistance. In the whole of the circular there is no reference to watts per C.P., and I think, therefore, that the figures appearing hereunder, which are the result of tests made on one of these switches obtained out of stock from a contractor, will be interesting :—

Position of switch.	Total watts.	Lamp watts.	Resistance watts.	C.P.	Watts per C.P.	Total watts per C.P.
Full on	64	64	0	42	1·52	1·52
1st stop	52	34	18	9	3·77	5·77
2nd stop	44	21	23	2	10·5	22
3rd stop	38	15	23	·7x	21·4x	54x
4th stop	30	8	22	·2x	40 x	150x

x = approx.

These figures were obtained with a metallic-filament lamp, and if a carbon lamp had been used, the watts per C.P. would have been much heavier.

I should not think of recommending a device which entails such a heavy and wasteful expenditure of energy per C.P. obtained. It would be far better and more economical to use two lamps, one of the C.P. required for ordinary illumination, and the other of small C.P. to be used as a night light. In this way a consumer would get something like good value for his money. I believe lamp makers can produce lamps with the two filaments in one bulb, and that such lamps are already on the market, this being a reasonably efficient and economical arrangement.

Geo. Wilkinson.

Electricity Works, Harrogate,
December 30th, 1910.

[Our correspondent's remarks are, no doubt, technically quite correct, and "turn-down" carbon lamps of 8 or 16 C.P., with a second filament giving 1 C.P., can certainly be obtained. Unfortunately, even one candle is often found to be too much for a night-light, and the brightness of the filament is a disadvantage. A "red-hot hair-pin," affording the merest glimmer of light, and that of a warm tint, is required, and in sick-rooms, hospitals, &c., it must be obtained. The watts per candle really do not matter, though it must be granted that the total watts absorbed when the lamp is "turned down" may be of importance. The only alternative to the admittedly wasteful method attacked by Mr. Wilkinson appears to be a 1-C.P. filament surrounded by a tinted shade to absorb the excess of light and to conceal the bright filament. We have not seen a metallic-filament lamp provided with a turn-down filament, which indeed would be impracticable if of metal; and the high watts per candle of the carbon lamp at normal candle-power completely neutralise the economy due to the use of the 1-C.P. filament at night. But we see no inherent reason why a metallic-filament lamp should not be made, with a 1-C.P. carbon filament in addition, so as to combine the advantages of the two types.—EDS. E.R.]

The City Lighting.

In an article on "Public Lighting in the City of London," in your issue of 23rd inst., there is a paragraph relating to the lighting of the Central Meat Market, Smithfield, from which it might be inferred that the City of London Co. had obtained a contract for the lighting of these markets. I am writing, therefore, to inform you that this is not the case, as there is no lighting of any sort inside the markets which is not carried out by this company under a contract with the Corporation of London, which was recently renewed for a period of 60 years.

The arc lighting referred to is, no doubt, that installed on the *outside* of the market buildings and in the market roadways, which, being public thoroughfares, can hardly be regarded as part of the market lighting. Further, I think I am right in saying that the street arc lamps at Smithfield followed, and were not precedent to, the improved lighting at Billingsgate and Leadenhall Markets.

I shall be much obliged if you will give effect to this correction in your next issue.

G. M. Powell,
Manager and Secretary,
Smithfield Markets Electric Supply Co., Ltd.

London, E.C., *December 29th*, 1910.

The Students' Catechism on Book-keeping.

I shall be obliged if you will kindly spare me sufficient space to reply to the somewhat severe criticisms which your reviewer has thought fit to make upon some of the answers to questions contained in the above work.

I have no objection to criticism, however severe, so long as it is fair and well founded. Your reviewer selects two main points for special criticism, and in my humble judgment his observations upon the first point are based upon an arbitrary interpretation of the meaning of terms, while his remarks upon the second point are based upon a misapprehension.

Your reviewer disputes the accuracy of the statement that "a reserve fund *is an asset*," and asserts that "a reserve fund may be invested in the business creating it, or it may be invested in outside securities, or other forms of investment; but a reserve fund *is not an asset*." In the first place, I am entitled to say that his view is quite contrary to that held by eminent members of the accountancy profession. For example, Mr. Wm. Adgie, F.C.A., in his very able work on the subject, states (page 273) that "A

reserve fund *is an asset*, existing for the purpose of providing for a contingent or uncertain loss, either of a special or general nature." In the second place, I should like to know how a reserve fund can be invested, as stated by your reviewer, if, as he also states, it is not an asset? How, indeed, can a reserve fund exist at all if it is not an asset of some kind or other?

The fact is, your reviewer has fallen into the common error of confusing the meaning of the terms Reserve Account, which is a credit balance, and Reserve Fund, which, being an asset, must be a debit balance. Whether the reserve fund is or is not separated from the general assets of the business has no bearing on the question at issue.

With regard to the second point selected for criticism, viz., that which relates to the formalities connected with the payment of a dividend, I can only conclude that your reviewer has either misread or misunderstood the answer given in the catechism. He cannot be acquainted with the methods of bank book-keeping, otherwise he would not have the hardihood to deny the truth of the statement that "as the warrants are presented to the bank for payment, the dividend account at the bank will be debited." Your reviewer goes further—he gives his opinion of what would happen, but I can assure him, from long experience of such matters, that his method is a very unusual one, and is not one which I should deem it advisable to attempt to impart to students.

The Author.

[I have read your correspondent's letter, and I have also read the review to which he refers, which he accuses of being "somewhat severe," while he also takes exception to some observations made therein relative to two matters of more or less general interest. I submit that the terms of the review, far from being "severe," are distinctly favourable to Mr. Davey; and to or from the language used in relation to the two points named by Mr. Davey, in which there is neither "arbitrary interpretation," "misapprehension," nor confusion of terms, as alleged, I have nothing to add or to subtract. It is perfectly clear, and is merely the expression of what are indisputable facts, the stating of which does not involve "hardihood" or temerity.—The Reviewer.]

Hulton Colliery Disaster.

Referring to your note on the Hulton colliery disaster in your "Lighting and Power Notes" of the current issue, may I point out that the modern electrical equipment of the colliery dates back to eight years ago, not three or four as stated.

W. Bolton Shaw

(formerly Electrical Engineer to the Hulton Colliery Co.).

Bolton, *January 2nd*, 1911.

Railway Accidents; Summoning Assistance.

At various points in Brighton and Hove alarm posts are to be found wherefrom aid can be telephoned for, for casualties of all sorts. A recent railway accident gives me ground for hoping that similar alarm posts may be situate on every railway at a quarter of a mile apart from one another, unless, as in the case of the Metropolitan Railway, stations are so situate.

May I hope that you will allow this suggestion to be ventilated in your columns?

Henry James Saint Benno Cunliffe (M.A. Oxon.).

London, *December 29th*, 1910.

The Cherry-Bush Rotary Engine.

With reference to your description of this engine in your issue of December 30th, you do well to say that the claim of the makers to produce 1 H.P. for 5 lb. of steam per hour needs independent verification. Your doubts might have been expressed even more forcibly, because the claim is a long way outside the limits of theoretical possibility with an absolutely perfect ideal engine. Working roughly from a steam chart, I find that such an engine, using steam at 200-lb. pressure, with 200° of superheat, and exhausting into a 28-in. vacuum, would theoretically require at least 6½ lb. of steam per H.P., and no actual engine of small power could hope to approach this efficiency.

Fortunately, the claim made is so wildly absurd that it is not likely to mislead anybody who is worth misleading, but even so, it is as well that it should be refuted. If the consumption had been given as 50 lb. per B.H.P., it would probably have been much nearer to actual facts.

R. H. Parsons.

Peterborough, *January 1st*, 1911.

REVIEWS.

Electric Trains. By H. M. Hobart. London: Harper and Bros. Price 6s. net.

This little volume, as stated in the preface, deals only with the electrical equipment of trains, and that only of suburban trains. It does not, as might be expected from its title, treat of the electric locomotive, or of the mechanical portion of the train, but confines itself primarily to what might be designated the "preliminary investigation," such as speed-time diagrams, influence of momentum, power curves, &c. There is none but the briefest description of any line in actual operation, an omission which will, perhaps, meet with the approval of many readers, since descriptions with complete details of practically all the important lines have been published quite recently. Exception must be taken to the paragraph in the preface accusing the engineering profession of not taking cognisance of the 11 per cent. difference between the British and American tons. It is as unjustifiable as to state that the profession fails to recognise the difference of 20 per cent. between the British and American gallons.

Again, the preface states that:—"The electrical engineer will be out of his element in designing trucks and car bodies." As a matter of fact, it is essential that the electrical engineer should be a mechanical engineer, and the more the electrical engineer knows of mechanical engineering the better for him and the profession. It goes without saying that the engineer who is able to take hold of a scheme from both the electrical and the mechanical ends is a much more valuable man to his client than one who can advise on electrical matters only.

The volume opens in Chapter I with a description of speed-time diagrams, the method of obtaining them, and their use. The diagrams emphasise the superiority of the electric motor in suburban work over the steam locomotive, a superiority which is due to the high rate of acceleration which is peculiar to the electric motor. Chapter II is devoted to the influence of the number of stops per mile and the duration of such stops. The diagrams bring out most clearly the effect on the schedule speed of increasing the duration of the stop; thus, taking an average speed of 30 miles per hour, an increase of the duration of the stop on a one-mile run from 30 seconds to 60 seconds decreases the schedule speed from 24 to 20 miles per hour. No wonder "Step on, please!" is a familiar cry on the underground and tube railways.

The influence of momentum on a service with frequent stops is thoroughly investigated in Chapter III. Thus, at a schedule speed of 30 miles per hour and a distance between stops of one mile, the actual energy present as momentum amounts to no less than 61 per cent. of the total input to the train, a figure which shows how necessary it is to cut down the weight of the train to a minimum. Chapter IV, which, perhaps, is the most important in the volume, treats of the energy consumption of trains. Tables and curves giving the energy consumption and capacity of equipments for various schedule speeds and distances between stops form no small part of this interesting chapter. Chapter V investigates the efficiency of electrical equipments. A complete specification

is also given of a four-coach train on the Lancashire and Yorkshire Railway. The determination of the efficiency of the electrical equipment on the Central London Railway and a specification for a six-coach train on the same line form the contents of Chapter VI. Chapter VII is devoted to an analysis of energy consumption tests on the Great Northern, Piccadilly and Brompton Railway. Specifications for a six and a four-coach train are also included. Acceleration and tractive force are briefly discussed in Chapter VIII, while train friction provides material for Chapter IX. In the latter chapter the author points out that too great a portion of the decreased energy per ton of train for trains of heavy weight, when compared with lighter ones, has been put down to decreased air friction, whereas a considerable portion of the saving per ton is due to the increasing efficiency of the electrical equipments at the heavier loads. This mistake is quite a common one, and the author has done well to draw attention to it. "The predetermination of the power curve for a given journey" is thoroughly gone into in Chapter X. Table 46 gives the armature speeds and gear rates of typical D.C. and A.C. motors. The Heysham, Morecambe and Lancaster electrified branch of the Midland Railway is discussed and analysed in Chapter XI. Chapter XII deals with the heating of railway motors, and is chiefly confined to the G.E. 66A, G.E. 69B motors, as used on the Central London Railway and Great Northern, Piccadilly and Brompton Railways respectively, and the Dick, Kerr motors on the Lancashire and Yorkshire Railway, and to single-phase motors. Weights and costs, and summary and conclusions are covered in Chapters XIII and XIV.

The volume, without doubt, fills a gap; there are papers and volumes which deal with electric railways, but nothing dealing in a precise and clear way with an estimation of the energy required by electric trains. The author's method of procedure, his explanations, his numerical examples, well backed up by curves, cannot fail to convey to the reader a good knowledge of the subject, and, what is more, a grasp of the way to use such knowledge in attacking his every-day problems. Mistakes there are, but not of a serious nature. On page 171, in comparing continuous and alternating-current trains, 6 per cent. is added to the weights of the trains for the weight of the passengers, although both trains have the same seating capacity; thus, the alternating-current train is debited with 3 tons of passengers in excess of the corresponding direct-current train. The figures given by the author for the energy consumption for A.C. trains per ton-mile require revision in view of Mr. Philip Dawson's paper before the British Association, the consumption per ton-mile being given as 70 to 80 watt-hours (see *Engineering*, September 16th, 1910), and this at the power house. Even allowing 20 per cent. on the figure for lighting, shunting, &c., since Mr. Dawson does not state whether it is included, we have 96 watt-hours per ton-mile, as against 132 watt-hours given by the author, or a decrease on the author's figure of practically 26 per cent. The figures for the alternating-current equipments certainly require considerable modification in view of the present data obtainable. On the same page the words "single-phase" are omitted in the statement of gross inputs to the trains. Again, on page 172, the word "pence" is omitted. On page 158, the expression $125/90 \times 746$ should be $125/0{\cdot}9 \times 746 = 103{,}800$ watts.

Some of the expressions used can hardly be called correct English, thus—with the 16·1 miles per hour service two less trains are required, &c. Again, "The rolling stock constitutes 57 per cent. of the total, and the maintenance and depreciation are enough greater than on the other items to raise the annual costs associated with the third item to some 75 per cent. of the annual costs associated with the total of the three items." In some cases the spelling is faulty; thus, "supercession" for "supersession." Why call the armature shaft the armature axle? It is certainly not a good engineering term. Some of the figuring is very lax, and such an expression as "$55{\cdot}5/2 = 27{\cdot}6$ H.P." looks as if someone used a slide-rule where he should have used his head. It is questionable if it is correct even for rough calculation to take the gearing loss as a constant at all loads. In the case cited the gearing losses amount to 1·2 kg. per ton out of a total of 6·6 kg. per ton, or some 18 per cent. It seems to be quite unnecessary to keep referring to series-wound *continuous electricity* motors. Why not series-wound motors?

The above form the chief points for criticism, which the author will do well to correct in the next edition.

The volume is of a handy size, well printed, and provided with an excellent index and "list of tables." It is written in a very lucid style, and can certainly be recommended to all who are interested in this important branch of electrical engineering.

Exercises in Electrical Engineering. By T. MATHER, F.R.S., and G. W. O. HOWE, M.Sc. London: Edward Arnold. Price 1s. 6d. net.

This is a collection of electrical engineering questions set in the second-year exercise classes and examinations at the Central Technical College in recent years, revised where necessary, and classified. Their object is to cultivate familiarity with fundamental principles, in the form of an exact working knowledge, and the authors regard it as essential that, in the exercise classes, the students should be encouraged to discuss the questions with the lecturer and with each other, a view which commands the approval of all practical men. The questions are admirably calculated to achieve the purpose of the authors, and should be of great assistance to others responsible for the conduct of classes in electrical engineering; they cover a very wide range, and number over 400. Many of them are illustrated, and answers are given (at the end of the book) to numerical questions. Such answers should never be given at the end of the questions themselves, as the student cannot help catching sight of them, and being unconsciously influenced by a knowledge of the order of the result, which to a great extent nullifies the advantages otherwise derived from solving the problem.

BUSINESS NOTES.

Buenos Ayres Exhibition Awards.—The following is a general list of awards made to exhibitors of different countries at the recent Argentine Centennial Exhibitions (Railway and Land Transport Exhibition):—

	Grand Prix.	Diploma de Honor.	Gold Medal.	Silver Medal.	Bronze Medal.	Hon. Mention.	Total.
Great Britain...	82	12	75	39	12	2	222
Germany ...	70	35	41	18	5	2	171
Italy	70	35	40	5	2	3	155
France ...	64	25	25	4	—	4	122
U.S.A. ...	21	8	33	6	—	4	72
Austria ...	26	17	17	3	—	2	65
Belgium ...	31	9	3	2	—	—	45
National ...	17	3	8	5	3	1	37
Cosmopolitan...	11	10	4	5	1	—	31
	392	154	246	87	23	18	920

Marine Electrical Work in 1910.—MESSRS. W. C. MARTIN & CO., who have long specialised in marine electrical work at Glasgow and elsewhere, report that in that department 1910 was an uneventful year. Their system of electrical plant, wiring and fittings was, however, installed on board a considerable number of passenger and cargo steamers built during the year. Among these was the R.M.S. *Franconia*, built at Wallsend for the Cunard Line, which they have just equipped with an electric light and power installation, comprising about 3,500 lights in addition to electric bells, clocks, fans, telephones, &c., as well as over 200 H.P. in electric power for ventilation, heating, culinary, and other appliances. Another vessel worthy of notice, and equipped by the firm, is the Royal Holland Lloyd steamer, *Zeelandia*, which has an installation of some 900 electric lights, besides ventilating fans, electric radiators, cigar lighters, bells, telephones, and other appliances. This vessel is also fitted with a system of electric thermometers, which indicate on a dial in the engine room the exact temperature of the refrigerating chambers. These thermometers have the advantage that they can be distributed in the most inaccessible positions on board ships, obviating the necessity of personal inspection of these places when it is desired to read the temperature, besides avoiding the opening and closing of doors and interference with the uniformity of the temperature in these compartments. An electric rudder indicator is also provided on this vessel, which, at a glance, shows on a dial fixed in the wheel house, the exact position or angle taken up by the rudder. This installation, as well as the ship itself, has been equipped in a most luxurious manner, and is practically a repeat of the ss. *Hollandia* fitted last year for the same owners. Messrs. Martin have also fitted several vessels for

the British India Steam Navigation Co., Ltd., including the ss. *Leruka*, the ss. *Arankola*, and the ill-fated ss. *Abhona*. Among other work carried out during the year, were the ss. *Inventor* and the ss. *Explorer*, for the Harrison Line, of Liverpool; the ss. *Royal Scot*, for the London and Edinburgh Shipping Co., Ltd.; the ss. *Bandon*, for the City of Cork Steam Packet Co., Ltd.; the ps. *Duchess of Richmond*, for the London, Brighton and South Coast Railway Co.; the ss. *Den of Glamis*, for Messrs. Chas. Barrie and Sons, Ltd., Dundee; the ss. *Renvoyle*, for Canadian owners; and others. As regards prospects for 1911, a very busy year is expected by the firm. The orders already booked, comprise among other work, the R.M.S. *Laconia* for the Cunard Line, being a repeat of the *Franconia* mentioned above; the t.ss. *Cameronia*, for the Anchor Line, which is a repeat of the t.ss. *Columbia*, *Caledonia*, and *California*, fitted out by them for same owners, and makes the twentieth vessel for that company. For the British India Steam Navigation Co., Ltd., they have in hand the two steamers *Ellanga* and a sister vessel; a large passenger vessel for Italian owners; the ss. *Ballycotton* and *Warner*, for the Clyde Shipping Co., Ltd.; the ss. *Mindini*, and another large passenger steamer for Messrs. Burns, Philp & Co., Ltd., Sydney. They have also secured the order to provide an extensive electric light and power installation on a large and handsomely equipped passenger steamer building at Trieste, for Messrs. Austro-Americana. This will be the largest and most powerful vessel ever built in Austria. We understand that it is becoming more and more the practice to have the working of the ship controlled by electricity from the chart room, which in the future will resemble the conning tower of a battleship.

Book Notices.—*Hazell's Annual*, 1911. London: Hazell, Watson & Viney, Ltd. 3s. 6d. net.—This useful annual has been delayed in its appearance on this occasion in order that a history of the very short Parliament (1910), and a complete guide to the new House of Commons might be included. The volume is unique in recording the passage of two Finance Acts, the results of two General Elections, and the names of the members of two Houses of Commons. In addition to a vast amount of information of a general kind of value for reference, there is a brief review of electrical and engineering progress during the year. There is also useful matter concerning the following subjects coming within our scope:—British and foreign canals, the iron and steel trade of the world, railways of the world, scientific progress in 1910, scientific societies of the United Kingdom, telegraph cables, telephone statistics, textile industries of the world, tramway statistics, and wireless telegraphy.

Journal of the Municipal School of Technology, Manchester. Vol. 3. Manchester: The Education Committee.—This is a record of the investigations undertaken by members of the staff and students of the School in 1909—printed in the Photography and Printing Crafts Department of the School, in a style which reflects the greatest credit upon the technical ability and artistic taste of those responsible for its production. Some of the papers here reproduced have already become classical; for example, the research conducted by Prof. J. T. Nicolson into the laws of heat transmission in steam boilers. The subjects dealt with cover a wide range of engineering, chemical and industrial interest, and the whole forms a volume of nearly 400 pages, which in every way does honour to the institution from which it emanates.

"*Practical Engineer* Pocket-Book and Diary" and "The *Practical Engineer* Electrical Pocket-Book and Diary." 1911. London: Technical Publishing Co., Ltd. Price 1s. 6d. net each.—These books have, as usual, been revised to bring them into line with current practice, which changes so rapidly, in electrical work especially, that frequent revision is indispensable. The *Practical Engineer* pocket-book now contains over 700 pages, though much old matter has been cut out to make room for more important items; the new matter covers a wide range of engineering interest, especially in connection with steam plant, power transmission and workshop practice. Its Electrical companion has also received various additions relating to the different equaliser systems for colliery winding and rolling-mill driving, balancers and boosters, metallic-filament lamps, the 1909 Electric Lighting Act, &c. We note that the ratio of the Hefner unit to the British candle is given on page 343 as ·88 to 1, whereas it is ·9 to 1, as on page 335; but a cursory examination has not brought to light any error of importance.

The Practical Electricians' Pocket Book and Diary, 1911. London: S. Rentell & Co., Ltd. Price 1s. net.—This handy little book, which is remarkably well got up, has undergone the annual revision, which always seems to involve also an increase in bulk. A new section on Armature Winding and Repairs has been inserted, the arc lamp section has been rewritten and greatly improved, new wiring systems have been described, and numerous minor amendments have been effected. In the central station tables, the names of the chief engineers have been added. The diary and requisition forms, &c., at the end of the book are especially convenient and useful.

The Electrical Engineers' Diary, 1911. London: S. Davis & Co. Price 2s. 6d.—The bulk of this annual is, of course, constituted by the diary, giving a week to an opening, interleaved with blotting paper, and affording ample space, we should think, for any but the most verbose user to inscribe his daily records in. But, as in the previous edition, there is also a very useful section, consisting of some 60 pages of electrical rules, tables and data, relating to electric lighting, heating and power applications, with the Electrical Contractors' model specification for wiring, the Home Office Regulations, &c., and a useful index to manufactures under trade names, besides many pages of advertisements. There is also a list of the London streets in which mains are laid, with pressure and price of energy, and a directory of supply authorities of the United Kingdom. Thus it is a very compendious and informative production.

The Chemical Trade Directory, 1911. London: Messrs. Davis Brothers, 265, Strand, W.C. 10s. net.—This is the fourth edition of this directory. It is in three parts, the first of which contains an alphabetical list of names, with addresses of chemical manufacturers, merchants, agents, brokers, and makers of chemical plant and materials in Great Britain and Ireland. Part II includes classified lists of chemical products, &c., with the names and locations of the makers. Part III contains a great deal of useful information regarding Acts, legal decisions, price diagrams, export and imports, census of production, and so forth. The directory is practically indispensable to all connected with the trades with which it is concerned.

Fowler's Mechanics' and Machinists' Pocket-Book and Diary, 1911. Manchester: Scientific Publishing Co. Price 6d. net.—This is now in its third edition, and has been amended and extended. It is one of the most useful examples of its kind, and will be found of great service in the workshop, being full of practical notes and shop wisdom. We heartily recommend it to those who have not yet made its acquaintance.

"The Electrical Ignition of Petrol Engines." By J. W. Warr. 1910. London: H. Alabaster, Gatehouse & Co. Price 2s. net.

"Science Abstracts." Vol. 13, Part 12. Sections A and B. December 28th, 1910. London: E.& F. N. Spon, Ltd. Price 1s. 6d. net each.

"The College Quarterly." No. 5. November, 1910. Melbourne: The Working Men's College.

"Leçons sur l'Electricité." By Eric Gerard. Two vols. Paris: Gauthier-Villars. Price 12 fr. each.

"Annales des Postes, Télégraphes et Téléphones." No. 1. Paris: A. Dumas. Price 7 fr.

"*Journal* of the United States Artillery." Vol. 34, No. 3. With Index to current military literature and Index to Vol. 34. 1910. Fort Monroe: The Coast Artillery School Press.

"*Transactions* of the Institution of Engineers and Shipbuilders." Vol. LIII, 1909-10, with list of members, &c. Glasgow: The Institution. This volume contains several valuable papers and discussions, including "Electrically-Driven Reversing Rolling Mills," by C. A. Ablett; "Design of Surface Condensers," by R. M. Neilson, and "Steamship Repairs by Electric and Autogenous Welding," by A. Scott Younger.

"Railway Rebates from Private Sidings Traffic." By Harold Osborne. Liverpool: H. O. & J. Hutchinson, 3, Launcelot's Hey. Price 3s. 6d. net.

"Elementary Principles of Alternating-Current Dynamo Design." By A. G. Ellis. London: Blackie & Son.

"Annual Report of the Glasgow and West of Scotland Technical College." 1910. Glasgow: The College.

"*Bulletin* of the Association des Ingénieurs Electriciens." December 20th, 1910. Liége: rue St. Gilles, 31.

"Elektrotechnische Winke fur Architekten und Hausbesitzer." By L. Bloch and R. Zaudy. Berlin: Julius Springer. Price M. 2·80.

Calendars and Catalogues.—THE WESTERN ELECTRIC CO., LTD., of Norfolk House, Victoria Embankment, London, W.C., have issued a neat calendar either to stand or to hang. It has monthly slips with very plainly printed figuring.

From THE UNION ELECTRIC CO., LTD., Park Street, Southwark, S.E., we have received a couple of memoranda slip blocks which we shall use as long as they will last, remembering to whom we are indebted for them.

MESSRS. NALDER BROS. & THOMPSON, LTD., 34, Queen Street, London, E.C., have once more circulated among their friends their handy, serviceable, and unimposing calendar for 1911, with tear-off monthly slips.

MESSRS. MCCLURE & WHITFIELD, of the Mersey Dynamo Works, Adswood, Stockport, once more favour us with one of their useful pocket diaries, in which there is ample space for daily notes, an insurance coupon, much general information, and a number of pages containing illustrations and descriptive matter regarding their generators and motors.

We are pleased again to receive the very useful blotting pad and diary of the ELECTRICAL POWER STORAGE CO., LTD., 4, Great Winchester Street, London, E.C. For years we and others have given this a place of honour. The monthly strip of dates along the top ledge is very handy and the diary at left-hand side contains a £500 Ocean railway accident policy, a few pages of priced and illustrated information regarding E.P.S. cells, and ample space for daily entries—a week to a page, blotting being interleaved as usual.

MESSRS. FALK, STADELMANN & CO., LTD., of 83-87, Farringdon Road, London, E.C., have issued an effective "Efesca" lamp calendar for 1911. It has weekly tear off slips, each date being printed in a lamp. Above the date-block and card is a coloured representation of our old familiar "Efesca" friend within a bulb. The whole is neat and, as we say, effective.

MR. CHAS. H. BLUME, of White Building, Fitzalan Square, Sheffield, send us a wall calendar with monthly slips for 1911. It gives notes regarding the purposes for which their "Megomac" and "Insulac" varnishes, and other specialities of a like kind, are particularly adapted.

MESSRS. BAXTER & CAUNTER, 86, Charing Cross Road, London, W.C.—This is a very fine catalogue of close upon 300 pages. It is entitled "Everything Electrical," and is got up in excellent style with a serviceable and good class binding. A stout enamelled paper is used throughout, enabling the numerous illustrations to be set off effectively. The opening pages contain an index and some

14 pages of useful electrical tables, data and general information of service to those interested in lighting and power installations, including water-turbine plants. There then follow the illustrated and priced particulars of a very wide range of electrical manufactures spread over a dozen sections. These 12 sections are as follows—each of them will be issued separately to those requiring them in that form:—A, accessories (lampholders, cut-outs, switches, fuses, candle fittings, &c.); B, engines (oil, gas and steam engines, suction gas plants, direct-coupled ship and other lighting sets, petrol and paraffin sets); C, motors (A.C. and D.C. motors, grinding and polishing machines, "Zone" dynamos and motors, motor starters, regulators, motor control panels, controllers, &c.); D, electric fans, propeller fans, &c.; E, switchgear, ironclad switches, instruments, circuit-breakers, switchboards, transformers, &c.; F, Eclipse and Economic heating and cooking appliances, with figures relating to cost of operating; G, bells and telephones, batteries, &c.; H, wires and cables, insulators; I, conduits and conduit fittings; J, water-tight fittings, hand lamps, weatherproof lantern heads, cluster fittings, shades, &c.; K, "Victor" flame arc lamps, carbons; L, Colonial accumulators. Several supplementary lists are as follows:—Price list of flame arc lamp carbons; price list of "Z" metallic-filament lamps; price sheet of "Conradty" carbons; 24-page list of electric bells, indicators, medical coils, domestic telephones, &c.; and a full 150-page catalogue (fully illustrated and priced and containing diagrams of connections) of telephones and telephone apparatus, fire alarms, mining bells, batteries, wires, insulators, &c. Messrs. Baxter & Caunter are, it will be remembered, British manufacturers, and they hold large stocks in London for prompt delivery.

THE STERLING TELEPHONE AND ELECTRIC CO., LTD., 200, Upper Thames Street, London, E.C.—Abridged catalogue (No. 170) of 76 pages, containing a number of revisions, these relating to the "Primax" system of common-battery automatic intercommunication telephones, portable magneto telephones, wall junction boxes, and telephone wires and cables. Also publication No. 175, containing 24 pages of diagrams of connections for Sterling telephones.

From MESSRS. JOHNSON & PHILLIPS, LTD., Victoria Works, Charlton, Kent, we have once again received one of their handy waistcoat-pocket diaries and engagement books for the current year. A calendar for the entire year, followed by some pages regarding the J. & P. manufactures, are at the beginning, the bulk of a very acceptable book consisting of ample daily spaces for the year.

THE BRUSH ELECTRICAL ENGINEERING CO., LTD., of Loughborough, has sent us a wall-calendar for the year 1911. Beneath a charming view in effective colouring is fixed a block of daily tear-off slips forming the Historical Events Calendar. We congratulate the company upon producing what nobody can regard as unworthy of a place on their walls.

THE SUN ELECTRICAL CO., LTD., 118-120, Charing Cross Road, London, W.C.—A new catalogue (No. 204) of advertising signs and flashers is just being issued to the trade. This is the second complete new edition within 12 months, owing to the demand. A number of examples of new designs using luminous raised opal letters are included, also the latest Sun practice in sign flashers, namely, their magnetic mercury contact type. Some 32 pages of illustrated and priced matter describes fixed and changing colour signs, window and counter signs, Thermo-Blink flashers, time switches, outside lanterns, &c.

MESSRS. THERMIT, LTD., of 27, St. Martin's Lane, Cannon Street, London, E.C., again are issuing one of their pocket note-books, with calendars for 1911 and 1912, preceded by some 30 pages regarding the "Thermit" welding process, tests, and some other pages containing information of general value.

MESSRS. POPE'S ELECTRIC LAMP CO., LTD., Hythe Road, Willesden.—This firm is issuing a calendar, with monthly tear-off slips for 1911, bearing the same effective Sphinx-like representation that appears on their show-card. The calendar does not bear the firm's name and address.

MESSRS. BERRY, SKINNER & CO., 78, Upper Thames Street, London, E.C.—New 16-page catalogue (No. 1,111, entirely remodelled) describing Berry's "Masta" patent fool-proof interlocked switchgear. Specifications in abbreviated style are given of push and pull fused-switches, ironclad fused-switch gear, inspection chambers for fused-switches, change-over combinations, enclosed and rewirable fuses and accessories. Prices and code-words are clearly rendered in tabulated form, and dimensions are similarly set out.

MESSRS. SIEMENS BROS. & CO., LTD., Caxton House, Westminster, London, S.W.—Eight-page supplement No. 3 to catalogue No. 508, containing full description of their portable frequency indicators, and notes of prices of small and large sizes, also description of demonstration instruments (moving coil, electro-magnetic and Ferraris types), and prices of same.

THE HERRICK ENGINE CO., 74, Broadway, New York.—Fifty-six page pamphlet "announcing the discovery of the Herrick balanced rotary engine, and giving a full illustrated description of it, together with reports on tests.

THE BRITISH ALUMINIUM CO., LTD., 109, Queen Victoria Street, London, E.C.—Large postal card showing on one side a view of the works at Kinlochleven, and on the other a table of sizes, thicknesses, and weights of aluminium sheets.

MR. W. J. STOKVIS, Oude Kraan 62, Arnhem.—Thirty-four page list showing illustrations of a variety of choice Dutch fittings, also a loose leaflet giving brief description, sizes, and prices of same in polished and oxidised brass.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—The company has prepared, especially for the use of colliery officials, a large wall calendar for 1911 with monthly sheets, on each of which there appears in outstanding style the current month's dates, and up above them also those of the preceding and the succeeding months, so that really on each sheet one has a quarter of the year. But there is a great deal of other matter, too. Each sheet is adorned by fair-sized illustrations of plant supplied by the company for colliery installations, and some letterpress regarding their manufactures in this department. Copies of the calendar will be sent to any colliery upon application to the B.T.-H. Publication Department at Rugby.

THE ARMORDUCT MANUFACTURING CO., LTD., of Farringdon Avenue, London, E.C., have provided us with a refill for 1911 for their perpetual desk calendar. Users of the latter are again reminded that as dates expire the slips should not be destroyed, but turned over to the left of the board, so that a complete record of past notes may be kept.

THE ELECTRICAL CO. (METER DEPARTMENT), 122-124, Charing Cross Road, London, W.C.—Twelve-page pamphlet, entitled "Contact Resistance between Commutator and Brushes," with reference to continuous-current ampere-hour motor meters.

ALLGEMEINE ELEKTRICITATS-GESELLSCHAFT, Friedrich Karl-Ufer 2-4, Berlin, N.W.—Leaflet describing a portable precision-wattmeter for direct and alternating current, with self-contained resistances up to 600 volts, and capable of carrying 200 amperes. The instrument is constructed on the dynamometer principle, with air damping, and has two current ranges and four pressure ranges.

THE DUSSEK BITUMEN CO., Canal Bank, Deptford, London, S.E.—A breast-pocket size diary for 1911, with insurance coupon, has been received from this firm. Wire-gauge tables, British standard tables of conductors, weights and measures information, and general "daily wants" matter occupy the opening pages, the remainder consisting of memoranda and diary spaces, which should prove sufficient for most purposes. The cover does not bear the firm's name, and the book has a general style about it of which no one need be ashamed.

THE SUN ELECTRICAL CO., LTD., 118 and 120, Charing Cross Road, London, W.C.—Leaflet No. 206, containing a full description with neat illustrations, of their "Flexalite" patent electric candle fitting; also a priced list of improved Holophane reflectors (Stiletto).

MESSRS. COX-WALKERS, LTD., Darlington.—Leaflet illustrating and briefly describing and giving prices of their automatic starters for pumps, air compressors, hydraulic machinery, organ blowing, &c.

THE ATLAS METAL AND ALLOYS CO., LTD., 52, Queen Victoria Street, London, E.C.—A perpetual type calendar, with cards to alter daily, reaches us from this firm.

MESSRS. G. J. EDWARDS & SON, LTD., 32-34, Great Sutton Street, Clerkenwell, E.C.—A large single sheet for wall service plainly arranges, in clear type, the dates for the entire year 1911. Beneath this calendar is a long list of belting, engineers' tools, and similar stores and sundries that the firm holds in stock.

Receiver Appointed.—THE SMALL POWER DYNAMO AND MOTOR CO., LTD.—Mr. J. H. Bayley (Bayley, Wood & Co.), 2, Booth Street, Manchester, was appointed receiver on December 16th.

Trade Announcements.—MESSRS. WM. SOUTTER AND SONS, LTD., of Farm Street Works, Birmingham, announce that Mr. J. J. Smith, 46A, Holborn Viaduct, E.C., who has successfully acted as their London and district representative for 30 years, is not continuing to work the agency. Messrs. Soutter are on Monday next, January 9th, opening new showrooms at Bath House, 57 to 60, Holborn Viaduct, E.C., where Mr. E. H. Cooper (who has for many years represented them in parts of the Midlands and South Coast district) will act for London and district. A number of new models of electric light fittings will be on view in the showroom.

THE INDESTRUCTIBLE CABLE CO. has removed to 20, High Holborn, London, W.C., and all correspondence should now be addressed there.

MESSRS. SIEMENS BROTHERS DYNAMO WORKS, LTD., Tyssen Street, Dalston, N.E., are this week installing an additional telephone line. They will still further increase the number of Dalston lines early in the New Year.

MESSRS. JOHNSON & PHILLIPS, LTD., announce that they have opened the following branch offices, showrooms and stores, at which they are carrying a stock of their Association and non-Association cables, wires and flexibles, and various electric light and power accessories:—

Address.	Telephones.	Telegrams.
Birmingham: 187, Corporation Street	Central, 7321	"Selbac, Birmingham."
Cardiff: 12, Castle Arcade	Cardiff, 1937	"Selbac, Cardiff."
Dublin: 27, Anne Street South	Dublin, 2088	"Selbac, Dublin."
Glasgow: 159, West George Street	Central, 2391	"Megohm, Glasgow."
Leeds: 21, Bridge End	Central, 4040	"Juno, Leeds."
Manchester: 251, Deansgate	Central, 4174	"Selbac, Manchester."
Newcastle-on-Tyne: 44B, Blackett Street	Central, 1691	"Selbac, Newcastle-on-Tyne."

THE GENERAL ELECTRIC CO., LTD., of Queen Victoria Street, E.C., announce that, owing to the difficulty and inconvenience often experienced by their customers in telephoning to their head office, they have added another four lines to their already large exchange, making a total of 19 lines in all.

Geipel's Steam Traps.—We are informed by MESSRS. WM. GEIPEL & CO., St. Thomas Street, London, S.E., that during the past year their business in steam traps has substantially increased, particularly in the "Rapidity" type that is now rapidly replacing the older type. Amongst the orders which have recently been executed, is one for the De Beers Consolidated Mines for 92

'Rapidity" traps, having a total discharge capacity of 1,000,000 lb. of water per hour at 100-lb. pressure. The total radiating surface is only 40 sq. ft., representing a loss by radiation of the equivalent of 20 tons of coal per annum. For a similar duty with float traps, the loss of coal would be about 500 tons, and the first cost more than double. Other orders include traps for battleships and smaller vessels for the English Navy, as well as for several foreign Navies.

Dissolutions and Liquidations. — ENGINEERING UNDERTAKINGS, LTD.—This company is winding-up voluntarily, with Mr. T. E. Kay, of 19, Johnson Street, Cheetham, Manchester, as liquidator.

THE TELEGRAPHIC CODE CO., LTD.—This company is winding-up voluntarily, with Mr. A. W. Good, 318, Moorgate Station Chambers, Moorfields, E.C., as liquidator.

BEAUMONT & STILL COLONIAL AND FOREIGN TRAIN LIGHTING CO., LTD., and the BEAUMONT & STILL TRAIN LIGHTING CO., LTD.—These companies are winding up. Meetings of creditors were called for January 4th at 29, Charles Street, Hatton Garden, E.C., by Mr. C. T. Burke, the liquidator.

BRITISH ELECTRICAL DEVICE CO., LTD.—This company is winding up voluntarily, with Mr. P. J. Boucher, 72, Victoria Street, S.W., as liquidator. A meeting of creditors is to be held at 1, York Buildings, W.C., on January 16th.

JESSON BIRKETT & Co., LTD.—A meeting of creditors will be held at Queen's College, Paradise Street, Birmingham, on January 12th. Liquidator, Mr. G. J. Bowker, at that address.

R. STEEL & Co., electrical engineers, 38, Bath Street, Glasgow. —The partnership of Messrs. Robert Steel and Thomas Hamilton, trading as R. Steel & Co., has been dissolved. Mr. R. T. Dunlop, accountant, 58, Renfield Street, Glasgow, has been appointed liquidator, and will receive all debts and discharge all accounts.

Edison Accumulators.—The Deutsche Edison Akkumulatoren Co., of 35-38 Dronthermerstrasse, Berlin, is now supplying a series of small Edison accumulators for ignition and lighting purposes on motor-cars. The 4-volt batteries are being made in sizes ranging from 8 to 58 ampere-hour capacity, and the lighting cells in 4, 8 and 12-volt sets ranging from 8 to 76 ampere-hours.

For Sale.—THE LAMBTON COLLIERIES CO., LTD., have for disposal a quantity of direct-current plant, cable, &c. See our advertisement pages in this issue.

LIGHTING and POWER NOTES.

Australia.—SYDNEY.—It has been decided that the draft agreement with the municipality of Annandale for the extension of the Council's electric light undertaking, be approved and adopted. Tenders are to be called for the erection of a platform for the new control switchboard, at the power house; also for (*a*) coal-measuring boxes, chutes and automatic counting devices for new coal hoppers at the power house extensions, and (*b*) copper bar for switchboard bus-bars at the Town Hall, Lang Park and Gipps Street sub-stations.

The city electrical engineer has furnished an important report to the Electric Lighting Committee on a proposal to do away with gas altogether in the matter of street lighting. In this he stated that a survey of the portion of the city not electrically lighted was made, and estimates made which show that the cost of erecting and connecting electric lamps in all the streets at present lighted by gas, would be £26,100. Assuming that the electric light department was credited with £23 for each arc and £3 7s. 6d. for each incandescent lamp per annum, the revenue would be £10,718 per annum. The following figures are of interest. Gas: Total gas lamps in use, 1,755; annual payment to gas company for these lamps, £10,500; total C.P. at 50-C.P. per lamp, 87,750; cost per C.P. per annum, 2s. 4·7d. Electric: Total electric lamps proposed—arc, 320; incandescent, 995; annual credit to electric light department, £10,718; total candle-power, taking arcs at 1,500 and incandescents at 50 C.P. each, 529,750; cost per C.P. per annum, 4·8d.

Blackpool.—A consumer having been discovered diverting a circuit so that he obtained motor current at 1d. per unit for lighting purposes, for which he should have paid 5d. per unit, the T.C. has given public notice that future offenders will be forthwith prosecuted. In the case in question the consumer paid the full rate, a matter of about £20, and a prosecution was not undertaken.

Bolivia.—The contract for the electric lighting and power installations for Potosi has been given to a local firm, who probably have obtained the concession for some European concern. Work is already in progress on the reservoirs and canals. Good opportunities for similar installations are still to be found in the mining districts, but intending contractors would do well to study personally the special conditions obtaining in Bolivia.

Burnley.—The day before Christmas there was left only 420 KW. as spare plant, and at a meeting of his Committee, the borough electrical engineer subsequently called attention to the importance of providing additional generating plant to enable next winter's probable demand to be readily supplied, and to make full provision for stand-by plant in cases of emergency. Mr. Starkie says there can be no hesitation, after perusal of data given in his report, as to the requirements of the department, and it only remains a question of the capacity and type of plant to install. As delivery of plant could not be guaranteed under eight months, it is essential that immediate action should be taken. The existing plant has a capacity of 2,640 KW. The total demand on peak load is 2,000 KW., which, deducted from capacity of all existing plant, only leaves 640 KW. as spare plant to meet cases of breakdown, and in the event of it being the largest set (750 KW.), the situation at once becomes critical. The demand on the station at the present time has exceeded the most sanguine expectations, and it is apparent that the department is hardly prepared, even at the present time, to cope with a serious breakdown should one occur to the largest set and so disable it for a Saturday evening's load. The Committee requested the engineer to submit estimates for the installation of a 1,000-KW. generating set, with a view to an application being made to the L.G.B. for borrowing powers.

Canada.—The formation of a $10,000,000 company at Toronto is announced; it will be known as the Central Canada Power, Ltd. Under its charter it may carry on general hydraulic and electric business throughout Canada. It is believed that the new company is a merger of all lines in the West, and that the new concern will not operate in Ontario, where the Government Hydro-Electric Commission has captured the field. It has interests in Quebec and the Maritime Provinces, but the chief field of the company's operations will be in the West.

In some of the Western Ontario cities the rates for electricity since the advent of the Niagara hydro-electric power, have been very much cut. The London company are now cutting rates to meet the reduction made by the Hydro-Electric Commission. All of the important towns west of Toronto are now supplied with what power they need at cost rates. Towns east of Toronto, as Brockville, Cardinal, Cornwall, Morrisburg, &c., are now asking the Hydro-Electric Commission for power, and are about to get it. The farmers of Carlton County have appointed delegations to wait on the Government with the object of securing cheap power for agricultural purposes—such as for lighting the farms and stables—and power for pumping water and running the various implements in use, and also for the fertilisation of crops in an experimental way.

China.—It is reported from Shanghai that the East Asia Industry Co. has just concluded negotiations for a loan of £120,000 to the Hydro-Electric Power Co., of Hankow.

Cork.—The Committee of the Technical School has under consideration the lighting specifications of the new buildings. During a discussion in connection with this matter, the head science master stated that being informed that the Nottingham and Sheffield Institutes used gas, he made inquiries and found that the former had abandoned gas for electricity, and that the latter used gas (except in the workshops, where it was not considered suitable) as it cost only 1s. per 1,000 cb. ft.

Darlington.—The T.C. has entered into negotiations with the Cleveland Bridge and Engineering Co. with respect to a supply of energy to the works. If an arrangement is arrived at, the company will take about one-fourth of the energy generated at the Corporation works.

Deal.—The T.C. has decided to support the application of the Sandwich, Deal and Walmer E.L. Co. for a prov. order for E.L.

Derby.—The T.C. has decided to extend the mains so as to supply current to the Stretton's Brewery Co., Ltd., Ashbourne Road. Extensions are also being made to Messrs. Haslam's foundry and to Littleover Hollow.

Eastbourne.—The electrical engineer is to make inquiries with regard to the proposed hiring out of electric ovens under the Corporation's motor-hiring scheme. The electrical engineer is to draw up a specification and invite tenders for a suitable stoker for the large Babcock boiler.

Fleetwood.—In connection with the electricity undertaking it is reported that the units sold during November were 45,575, the revenue being £732 15s. New lights have been connected equivalent to 4,885 watts. The engineer reported that the new overhead travelling crane was working satisfactorily, and that the main switchboard would shortly be ready to receive the cables from the dynamos and from the old switchboard. The Fleetwood Chamber of Trade has written requesting the Council to consider the question of a reduction of price, especially for shop lighting.

India.—A scheme is under consideration for the arc lighting of Chowringhee and Chitpore Road, and at present various experiments and tests are being carried out with different types of arc lamps. The consulting engineer appointed by the Municipal Corporation, Mr. H. H Reynolds, M.I.E.E., and Mr. Eaton, of the Calcutta Electric Supply Co., are drawing up reports of their tests. Various local electrical firms have been asked to submit samples for tests.—*Indian Engineering.*

Lewes.—The Highways Committee of the T.C. has consented to the Lewes and District Electric Supply Co. erecting and maintaining, free of cost for a short period, several electric lamps in the town. The company says that it can give the Council a vastly improved light at little, if any, greater cost than the present lighting by gas.

(*Continued on page* 23.)

ELECTRIC SUPPLY AT PORT ELIZABETH, SOUTH AFRICA.

In giving a description of the electric lighting of Port Elizabeth, our readers will have before them another example of electrical engineering in South Africa.

The plant, which is under municipal control, has been in operation since 1906, and is practically the last of the principal South African schemes for electric lighting supply, but is none the less interesting on that account: the system is a three-wire D.C. one.

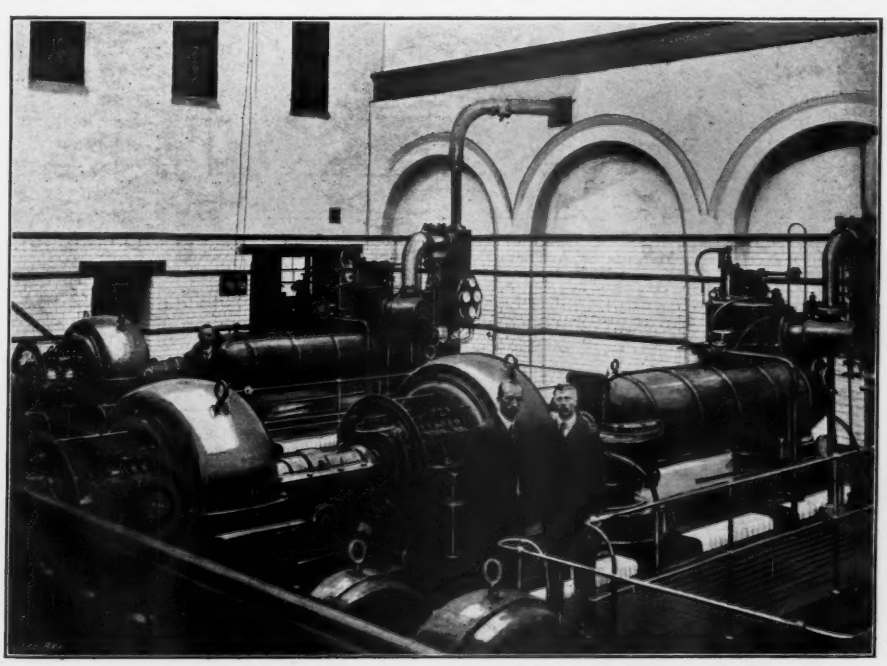
Electric tramways have been in operation since 1897 under the control of the Cape Electric Tramways Co., and it seems strange that the order of things has been reversed here—the electric tramways being first in the field, but this was due, no doubt, to party interests in the local gas company, which is a keen lighting competitor, the price of gas being 8s. 9d. per 1,000 ft., while electricity for lighting is 9d. per unit, and for power purposes, 3d. per unit. The town has a population of 21,277 white and 10,970 coloured people.

The works are situated at North End, which is 1·6 miles from the centre of the town, at which point there is a distributing sub-station in the Town Hall, from which the various feeders radiate.

The buildings, which were designed by the town engineer, were built of brick, at a cost of £9,000, and consist of an engine room 67 ft. long × 41 ft. wide; boiler house, 67 ft. × 26 ft. 6 in.; battery house, 60 ft × 27 ft.; workshop, 28 ft. × 20 ft., and the usual offices.

The boiler house contains three Babcock & Wilcox marine-type boilers, with an evaporative capacity of 10,000 lb. each, at a working pressure of 200 lb. per sq. in. with 150° F. superheat. The boilers are fitted with the usual valves of Hopkinson make and coking type mechanical stokers by Messrs. Babcock & Wilcox. The feed pumps are of Hayward, Tyler & Co.'s make, driven by Parker motors. The boilers are worked in conjunction with a Green's economiser. There are two chimneys of steel, brick lined.

The Port Elizabeth Electricity Station.



Interior of the Station, showing the Turbo-Generators.

The engine room contains three Brush-Parsons D.C. turbo-generator sets of 400 KW. each, with condensers of the surface type.

The switchboard is of artistic design, erected in an elevated recess in full view of the engine room, and consists of five panels supported on iron brackets with angle iron at the back. The panels carry three generator circuits, distributor circuits and a battery regulating board, and are provided with the usual recording instruments, switches, volt and ammeters, &c.

In front of the board, on the engine room floor, is the battery charging set. The battery consists of E.P.S. cells of 1,000 ampere-hours capacity, and is run on an average 17 hours per day, allowing of the steam plant being shut down except for the heavy load.

The cables are of the triple-concentric paper-insulated lead-covered class, laid on the solid system. There are four main feeders from the station, with a total length of 7,319 yards, and the distributor cables total 34,561 yards, and are arranged for intercommunication with each other by means of special boxes, of which there are 40 in use. There are also 4·28 miles of overhead mains for supplying outlying consumers, and these consist of bare wire supported on taper iron poles.

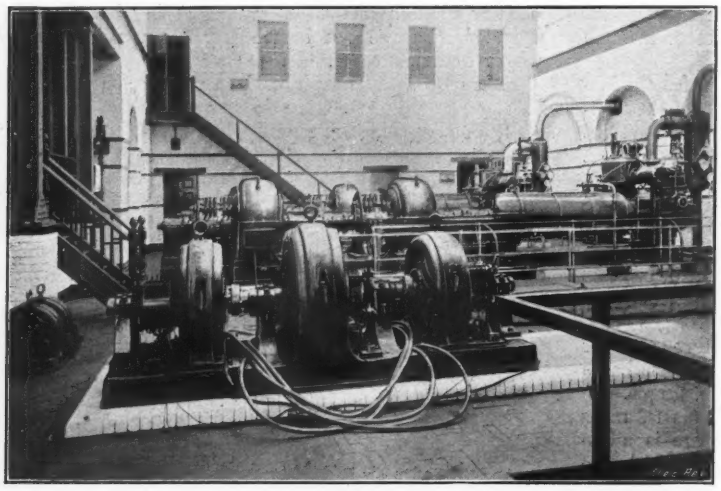
The street lighting cables total 70,801 yards in length, and the street lighting consists of 166 arc lamps of 3 and 10-ampere sizes and 447 incandescent lamps, 247 being Nernst and the remainder metal-filament lamps.

The Town Council have lately entered into a five years' agreement with the Government of the Cape Colony for the supply in bulk, for lighting and power purposes, of the harbour and railway works at 2d. per unit, with a minimum of 150,000 units per annum.

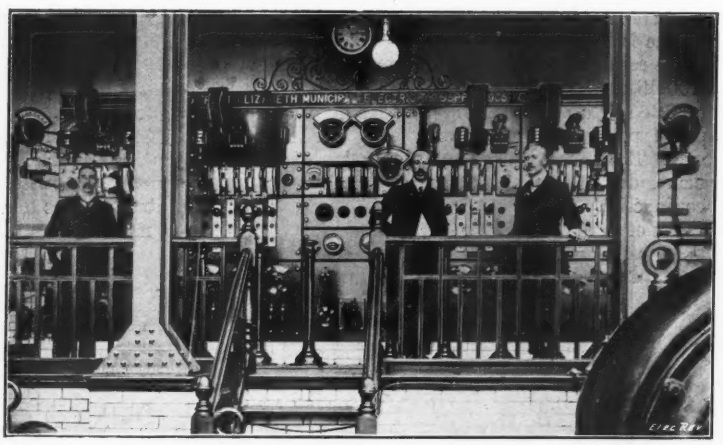
Year.	No. of consumers. Light.	Power.	Units gentd.	Works cost per unit.	Gross profit.
Dec., 1906 ...	193	12	161,319	5·023d.	£1,288
Dec., 1907 ...	364	30	493,544	3·087d.	£3,590
Dec., 1908 ...	556	54	728,425	2·867d.	£5,380
Dec., 1909 ...	722	68	838,035	2·103d.	£8,040

The wiring of installations is carried out by local contractors under the I.E.E. Rules, and a scheme of assisted wiring has lately been introduced by the municipality.

The meters used are of the Ferranti type, for which a rental of 6d. per month is charged, the consumers' pressure being 250 volts for lighting and 500 volts for power. There are 684 light consumers and 64 power consumers, the total H.P. connected being 680. The expenditure to date amounts to £130,000 out of an authorised loan of £150,000. The plant load factor for 1908 was 15·02 per cent. The table on the previous page may be of interest.



Interior of the Engine Room, Port Elizabeth.



The Main Switchboard, Port Elizabeth Electricity Station.

The consulting engineers are Messrs. Robert Hammond and Sons, London, and the electrical engineer is Mr. H. J. Holder, to whom we are indebted for these details. His assistant, Mr. W. A. Sholl, supplied the views illustrating this article.

The Battery Room.

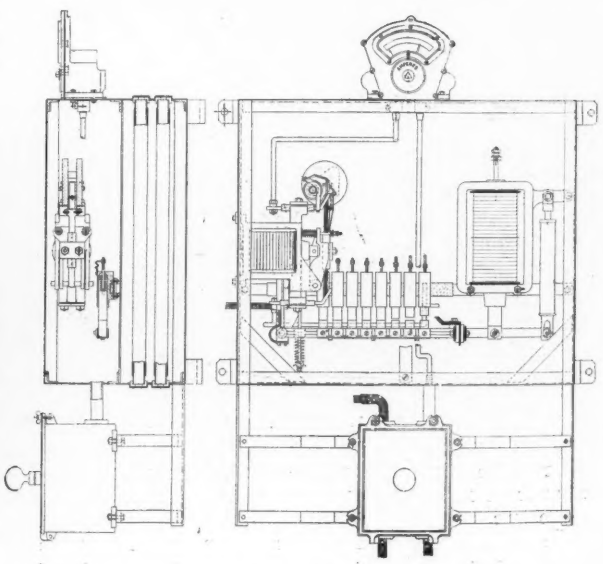
SEWAGE PUMPING AT NORWICH.

We illustrate herewith the Eaton sewage pumping station, situated beneath one of the streets of Norwich, which in its way is typical of the very numerous electrical sewage pumping installations which have been put to work in recent years in this country.

The arrangement consists of two concrete chambers, one 11 ft. × 7 ft. housing the pumps, motors, and switchgear, and adjoining a second concrete sump chamber 7 ft. wide and 16 ft. long, in which are fitted the pump suctions, screens, floats, &c. The sewage is delivered by a 9-in. pipe on to a screen formed with steel plates perforated with $\frac{3}{8}$-in. circular holes.

The pumps are self-charging, and the suctions draw from a corner of the sump, and are inside an auxiliary screen with $\frac{1}{2}$-in. diameter holes; the ordinary float which automatically controls the operation of the pumps is also situated within the auxiliary screen, and a storm float, which comes into operation when a surplus of water enters the sump, is situated some 5 ft. above the bottom. Both floats are coupled through guide wires, running over sheaves, to the switchgear of the motors in the pump chamber, and are arranged to operate the latter automatically.

Each float operates by means of the usual "tumbler" gear, on to a switch which works the relay circuit of one

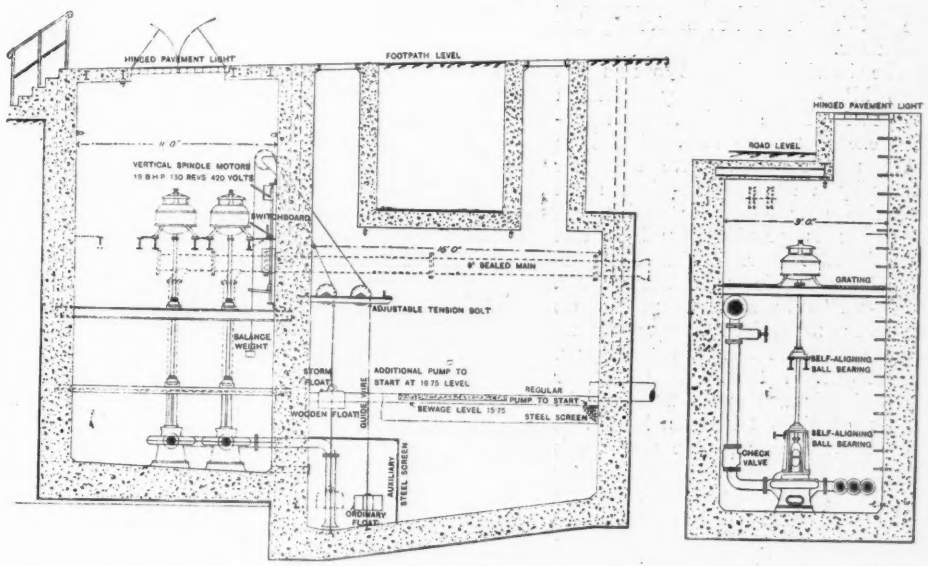


Laurence, Scott Starting Switch, Eaton Pumping Station.

or other of the starting switches, and a change-over switch is arranged between the starters and the float switches, so that either one of the motors is operated by the regular float switch and the other by the flood float switch. The motors and pumps can thus be used evenly, each taking regular duty one day or week, and then flood duty the next day or week.

The automatic starters are of the carbon-arm type, by means of which the resistance is cut-out on carbon blocks or plungers, thus eliminating sliding friction. The circuit, however, is not broken on these carbon blocks or plungers, but on the relay switch, the carbon blocks only unshorting the resistance after the main circuit is broken.

Two Rees Roturbo vertical spindle pumps of the single revolving pressure drum type are installed in the bottom of the pump chamber, each of 400 gallons per minute capacity, and working against a total head of 90 ft. The glands are fitted with lantern brasses, into which clean water is fed under pressure, in order to prevent the ingress of sewage grit into the bearings, and loss of vacuum through leaky packings. These pumps were fully described in the ELECTRICAL REVIEW for November 26th, 1909. The motors, which are compound-wound, each of 19 B.H.P. at 1,300 R.P.M., and operate on a 440-volt direct-current

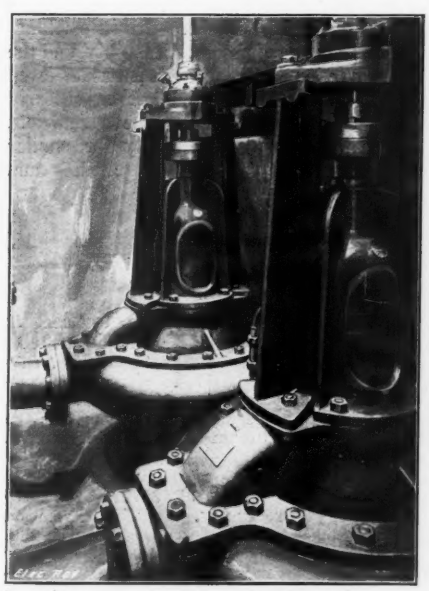


SECTIONAL VIEWS OF THE EATON SEWAGE PUMPING STATION, NORWICH.

circuit, are mounted on 7 in. × 4 in. joints, some 11 ft. above the pumps, the vertical coupling shafts being provided with self-aligning ball-bearings midway. The motors and switchgear were supplied by Messrs. Laurence, Scott and Co.; the plant is automatically controlled from the floats, as previously mentioned, the starting and stopping of the motors depending solely on the quantity of sewage entering the sump.

Our thanks are due to Mr. Arthur Collins, the city engineer, Norwich, for the particulars and views here given.

The Imperial Lamp Works.—A very interesting "break-up" for the Christmas holidays took place at the Imperial Lamp Works, Brimsdown, on Friday, December 23rd last. Every female employé, to the number of about 500, was presented with a gold and enamel brooch, and a fancy box of Christmas cakes. Every male employé received cigars, tobacco, or cigarettes. The presentations were made in the girls' dining hall, which was tastefully decorated and ornamented with Christmas trees, &c. At the end of the proceedings mutual good wishes were exchanged, and hearty cheers for the management given. Such things as these go a long way to maintain the cordial relations already existing between employers and employés at Brimsdown lamp works.



REES ROTURBO SEWAGE PUMPS.

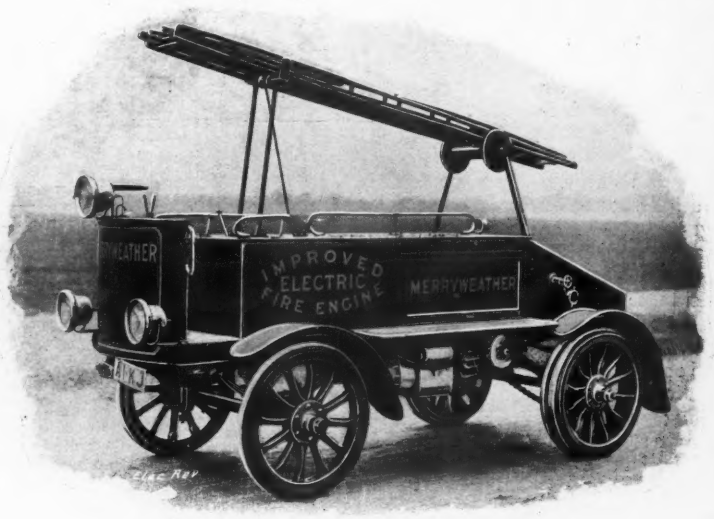
MOTORS AND SWITCHGEAR, EATON PUMPING STATION.

Electric Signalling.—With reference to the recent collision near Hawes Junction, Mr. R. N. Redmayne, of 14, Neville Street, Newcastle-on-Tyne, sends us particulars of the Brown-Mackenzie system of electric signalling on railways, claiming that if this system had been in use the disaster would have been impossible.

AN ELECTRICALLY-DRIVEN FIRE ENGINE.

THE electrical motor fire engine, which we illustrate herewith, is of special interest as being the first all-British machine of its kind. It has recently been introduced for first-aid purposes by Messrs. Merryweather & Sons, of Greenwich, the well-known makers of fire fighting appliances.

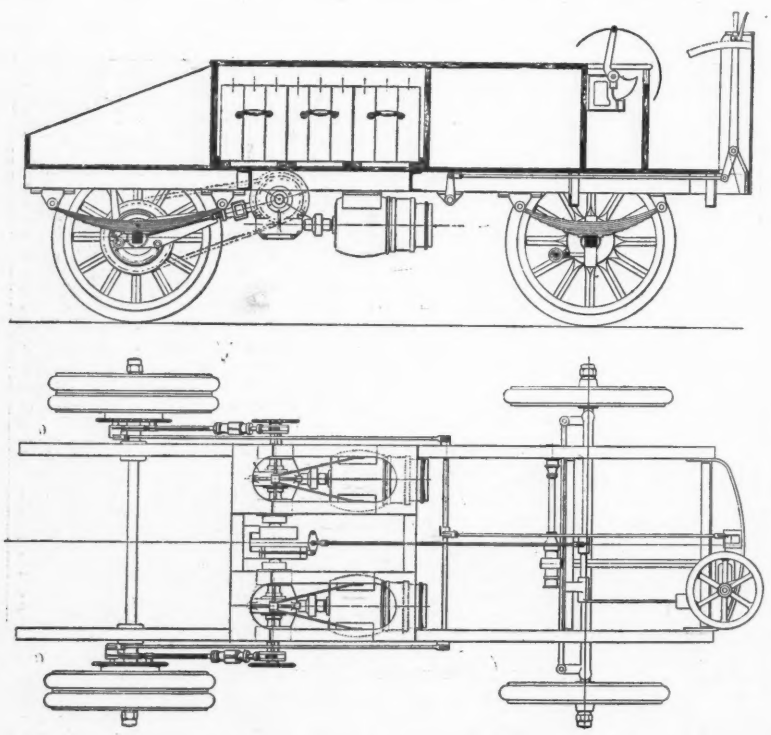
The electrical equipment consists of a light E.P.S. traction battery carried in the centre of the vehicle, which supplies energy to two independent high speed motors which drive the rear wheels by a silent worm-wheel speed reduction gear and roller chains. A large box is provided for hose and other hydrant gear, and the rear portion of the vehicle is fitted up with a "first-aid" cylinder carrying 35 gallons of water maintained under pressure by a cylinder of compressed CO_2 gas, and 120 ft. of 1 in. diameter rubber hose with branch and shut-off nozzle. A set of light telescopic ladders is carried overhead, and the machine is illuminated by three powerful electric head lights supplied with current from the battery. Seating accommodation is provided for six to eight men, in addition to an officer and driver, and the wheels are shod with solid rubber tires. The controller gives five speeds ahead and two astern.



THE MERRYWEATHER ELECTRICALLY-DRIVEN FIRE ENGINE.

A very good test of the engine's capabilities on the road was made on the day of the recent Parliamentary election at Greenwich, when this unique vehicle was pressed into service for carrying electors to the poll. Incidentally, it was an exceedingly interesting and instructive experiment as to what could really be done in the way of running a first-aid fire appliance, propelled by a storage battery, for long periods continuously, and under the severest possible conditions as regards stopping and starting. The neighbourhood of Greenwich has hills of exceeding steepness, on which the machine never faltered, the electrical equipment proving quite equal to the abnormal conditions imposed by the severe gradients. To anyone accustomed to a petrol-driven machine with the expert "double-shuffle" required when changing speed on a hill, the flexible electric drive is certainly a relief. It was found possible to run the machine continuously for 2½ hours without discharging the battery to an injurious degree, which is, of course, a far longer period than it would ever be called upon to run continuously for first-aid fire purposes, and the intervals for meals were ample for recharging.

There is no manner of doubt that for first-aid purposes pure and simple the electrically-propelled vehicle has a great future before it. Already most of the large towns on the Continent have adopted this form of traction in preference to petrol-driven machines on the score of absolute reliability, and the marvellous success which it has achieved in Vienna, Berlin, and other cities of equal magnitude, should be a sufficient guarantee of its suitability for similar purposes in our own large cities and urban districts.



ELEVATION AND PLAN OF THE MERRYWEATHER ENGINE.

Blackpool Time.—At its meeting on Thursday, December 29th, the T.C. decided to proceed with the scheme, submitted by the electrical engineer, for providing 100 electrically synchronised clocks, which are to be distributed throughout the borough, thus ensuring the correct time in every district.

Generating Alternating Currents of any Frequency.—In the article on this subject in our issue of December 2nd, it should have been stated that the inventor of the system is Mr. M. Osnos, chief engineer of Messrs. Felten & Guilleaume Lahmeyerwerke.

Correspondence Tuition. — The Prison Commissioners have, during the past year, experimented on the tuition of certain inmates of the Borstal Institutions, by means of the system provided by the International Correspondence Schools, and the trial has proved so successful that they have decided to go further into the matter, and to extend the tuition to convicts also. It is hoped in this way to provide the prisoners with a good mental stimulant, and to enable them to find employment on their release. The efficacy of the correspondence system is well exemplified by the results obtained.

LIGHTING and POWER NOTES.

(*Continued from page* 18.)

Billinge (Lancs.).—The U.D.C. has decided not to entertain the offer of the Bispham Hall Colliery to supply energy for public lighting.

Chichester.—The streets were lighted by electricity for the first time on New Year's day, the contract of the gas company, who have undertaken the public lighting of the city for upwards of 40 years, having expired at midnight on Saturday.

Continental Notes.—AUSTRIA.—The A.E.G. Union Elektricitäts Gesellshaft has entered into negotiations with various agricultural organisations and numerous communal authorities with the object of erecting a large central generating works for the supply of electric light and power to the whole of the Egerland region. The draft agreement has already been submitted.—*Der Elektrotechniker.*

SWITZERLAND.—A costly scheme for the nationalisation of hydraulic generating stations is about to be realised in Switzerland. The Governments of the Cantons of Zürich, Aargau, Glarus, St. Gall, Schwyz, and Schaffhausen are negotiating with the Aktiengesellschaft Beznau-Lontschwerk for the purchase of their station. The Government Council of St. Gallen has decided to buy up the shares of the Kubel Electric Works, having agreed to acquire as a preliminary the 3,800 shares recently offered to it; furthermore, to buy back from the Altstätter-Berneck Tramways their Rhine Valley generating station. Proposals to this effect will be introduced into the great Council next session. The Kubel Works have a share capital of 4,250,000 fr. (4,250 shares of 1,000 fr. each); the dividends in the last five years have amounted to 6 per cent., 7 per cent., 6 per cent., 6 per cent. and 8 per cent. Both shares and bonds are dealt in on the Zurich Stock Exchange. The Canton of St. Gall will probably acquire the shares at the current quotation—about 1,500 fr. each!

GERMANY.—A project for the utilisation of the portion of the river Rhine which runs through the kingdom of Baden has been launched by a financial group, at the head of which is the Aktiengesellschaft "Motor" (Baden), and the Middle Alsace electric supply works, called the Markirch-Kappenmühle Co., who will be joined by the Brown, Boveri Co., of Mannheim. Application for a concession has already been made to the Governments of Canton Aargau and of the Grand Duchy of Baden. It is intended to utilise the section of falls between Säckingen and the works of the Rheinfelden Electric Co.

The city of Barmen has entered into a long-period contract with the Elektricitätswerk Westfalen, according to which these two will co-operate for the supply of electric current and in the erection of a large generating station on the river Ruhr, probably in the neighbourhood of Hottingen. The station will be complete by the autumn, when current will be delivered not only to the Northward, in the special district of the Westfalen Co., but also southwards over the area controlled by the city of Barmen. The station will generate high-tension three-phase current at from 10,000 up to 25,000 volts. A steam turbine plant is to be installed. —*Zeitschrift für das Gesamte Turbinenwesen.*

Preliminary negotiations have taken place between the city of Coblenz and various districts on the Wiesbaden circuit with regard to the erection of a common electric generating station. The scheme is an ambitious one, the estimated cost being put at 21,000,000 marks.—*Elektrotechnik und Maschinenbau.*

RUSSIA.—A Reuter dispatch to the *Financial News* states that an application was filed recently before the Finnish Senate on behalf of a London firm for a concession to use the waters flowing from the Saima Lake for the provision of electric current for St. Petersburg, Helsingfors, and the electrification of Finnish railways. It is proposed to carry the water by means of a tunnel one mile long to Kuurmanjoki, where a generating station of 168,000 H.P. will be erected. The capital involved amounts to over £1,000,000 sterling.

SWEDEN.—The cost of harnessing the Alf-Karleby waterfalls in Dalelfven, from which 45,000 H.P. will be obtained, is estimated at 9,210,000 kr., and the time of construction at three years.—*Affärsvärlden.*

BELGIUM.—The old steam engines which drive the steel rolling mills at the works of the Société Metallurgique d'Esperance-Longdoz, Belgium, have been replaced by electric motors, the electric supply being obtained from the central station at Seraing, near Liège.

Fife.—At the new colliery at Valleyfield, belonging to the Fife Coal Co., Ltd., electric haulage plant is being installed by the British Electric Plant Co., Ltd., Alloa. It consists of three sets of haulages, each of 100 H.P. There are also four turbine pumps with a capacity of 500 gallons each, which were supplied by the Lahmeyer Co. The power plant comprises a 750-KW. three-phase 500-volt generator operated by a Willans engine.

Handsworth (Staffs.).—An installation of electric light has recently been carried out at the Wesleyan Sunday Schools, Somerset Road, by the District Electric Co., Ltd.

Halifax.—The Corporation proposes to spend £7,954 on extensions to the plant at the electricity works. The new plant comprises a 1,500-KW. turbo-generator, £3,073; condensing plant, £1,216; two 750-KW. rotary converters, £2,091; two transformers, £692; and switchgear, £882.

Hull.—On Monday the Electricity Committee visited the works in Sculcoates Lane, the sub-stations, the Hull and Barnsley Railway Co.'s new landing stage and Earle's Shipbuilding Yard. In arranging the tour, the chairman (Mr. Alderman Hanger) had in view the scheme for extensions, and the adoption of a more flexible system, in order to deal with the rapidly-increasing demand for electricity. The cost of the scheme is put at £99,322. Of this sum, £2,790, the price of the land required, would be paid out of the reserve fund; £91,536 for buildings, machinery and mains would be met by a 17 years' loan, and £4,996 for motors, to be let on hire, would be paid for by a 10 years' loan. The city treasurer, in reporting upon the financial aspect of the scheme, estimated an annual charge of £7,927 for 3½ per cent. interest and instalments, which is equal to a rate of 1·94d. in the £. Of course, it is anticipated that the amount will be more than met out of the revenue of the undertaking.

Leyton.—Mr. Camp, the canvasser to the electricity undertaking, requested the Council to reconsider his scale of commission, which had been diminished largely owing to the introduction of metal-filament lamps. The electrical engineer suggested that the scale of commission be amended from 1d. per equivalent 30-watt lamp all round to 3d. per equivalent 30-watt lamp for metal-filament lamps, and 1d. per equivalent 30-watt lamp for carbon-filament lamps and other lamps and apparatus. The commission for motors to be limited to £1 maximum, and that for cooking-oven sets to be based upon half the rated output. This suggestion was agreed to by the Council.

A Sub-Committee of the E.L. Committee recently visited the generating stations at Carlisle and Burslem, and the Central Electricity Supply Co.'s station at Wood Lane to inspect exhaust and mixed-pressure turbines at work, and has since agreed to support the recommendation of the Council's engineer to install a mixed-pressure turbine at the electricity works.

Long Eaton.—A somewhat belated copy of the Council's accounts for the year ended March 31st last, shows that the energy sold amounted to 1,123,549 units, a considerable advance on the 860,804 units of the previous year. Of the former amount, private consumers took 974,905 units—nearly 700,000 being for power purposes. The revenue at £7,014, compared with £5,965, and the net profit at £1,173, with £867 for 1909; the working expenses only increased some £560 during the year.

London.—HAMMERSMITH.—The Electricity Committee has had under consideration the necessity of extending the plant at the Council's generating station at an early date, and now recommends the addition of two boilers, with economisers, air heaters, mechanical stokers, forced draught, &c., and a new steel chimney, at a cost of £8,000; a 3,000-KW. turbo-alternator, with condensing plant, £10,000; mains extensions, £3,553; and additional services, meters, &c., £3,700—making a total estimated expenditure of £25,253. The Finance Committee has approved the estimates for the work, which is to be proceeded with at an early date.

PADDINGTON.—A very lengthy and involved report by the General Purposes Committee as to street lighting was considered at the meeting of the B.C. on Tuesday.

Estimates have been obtained from the Metropolitan Electric Supply Co. for lighting those parts of the borough in which its mains are laid, and these tenders, together with the cost of lighting the remainder of the borough with gas, as at present, amount to from £11,657 to £12,187—figures which compare with from £10,689 to £11,651 tendered by the gas company, for lighting the streets throughout, as at present.

The General Purposes Committee recommended that the tender of the Gas Light and Coke Co., with an annual cost of £11,651 for a period of 10 years, should be accepted, subject to consent being obtained from the L.C.C. to expend £13,000 under the heading of capital, but eventually the matter was referred back in order to consider a letter from the Electric Supply Co., asking for an opportunity of meeting the Council, to go into the details of the scheme.

Mexborough.—The Council has agreed to supply the Mexborough and District Water Co. with energy, on condition that it agrees to take £500 worth of energy during a period of five years, and that the charge for power purposes be at the rate of 1d. per unit if the quarterly consumption exceeds 10,000 units, and on the Council's scale if a less amount is taken.

Newcastle-on-Tyne.—According to the *Newcastle Chronicle*, the Newcastle-on-Tyne, County of Durham and allied companies report a good year as regards power connections, despite the slackness of trade generally. Among the large manufacturing and shipbuilding firms on Tyneside some 3,300 H.P. has been added, but the most notable growth is in colliery connections in both Northumberland and Durham, where the total increase amounted to about 5,000 H.P. Many other colliery electrification schemes are being carried out, and it is stated that altogether these represent contracts involving between 7,000 and 8,000 H.P. The Waste Heat Co., in conjunction with Messrs, Pease & Partners, is constructing a power station in connection with the coke oven plant at Bowden Close Colliery, for generating by means of turbines, &c., some 6,500 H.P., and the Dunston power station, with a capacity of some 30,000 H.P. of turbine machinery, is now in full operation.

Peterborough.—The borough engineer has presented a report to the Electricity Committee of the T.C. as to further capital outlay which he considers necessary in connection with the Cor-

poration electricity works. The principal works recommended by the engineer are as follows: A main distributor in London Road, including six two-armed pillars and one four-armed pillar, £375; feeder main to Westgate distributors, 765 yards, £487; mains and services as required, £795. The Committee decided that the T.C. should be recommended to apply to the L.G.B. for authority to borrow £2,000; the matter is, however, to stand over for the present.

Southborough.—The U.D.C. has appointed a Committee to formulate terms with the Tunbridge Wells T.C. for the supply of electricity to Broomhill and Bentham Hill.

Stoke-on-Trent.—The T.C. has instructed the electrical engineer to prepare a draft set of regulations for the wiring of premises for electric light.

Trowbridge.—The U.D.C. has approved of a draft agreement with Messrs. Edwards & Armstrong, of Bristol, for an E.L. scheme for the town. The scheme is to be like the one carried out at Chippenham.

Warrington.—The town clerk and electrical engineer are to report upon an application by the L. and N.W. Railway for the supply of current for lighting and power purposes to the company's Earlestown Works.

Wednesbury.—In order to encourage shop lighting by electricity, the Lighting Committee of the Corporation has prepared reduced charges, which entitle consumers under specified conditions to a reduction of ½d. per unit. This alteration came into operation on January 1st.

Worcester.—The High Sheriff of Worcester (Mr. A. H. Parker), who has been chairman of the Electricity Committee of the Corporation for 15 years, has resigned that position because he says the decision of the Council not to allow the Committee to act as agents for the supply of electrical apparatus makes him feel that the Corporation will not support him in doing what he can to work profitably an undertaking in which the citizens have invested a considerable sum of money. At the Council meeting on Tuesday he suggested that Mr. R. Clarke, another member of the Committee and a large brewer, would accept the post. Mr. Clarke said he could only occupy it if he received an assurance that the Council would give sympathetic attention to him, if he felt that the Committee must be in the position to offer consumers inducements in the way of securing apparatus for domestic purposes on favourable terms. He felt strongly that they could only increase their turnover by offering some such inducements. Whether the Council will accept Mr. Clarke as chairman of the Committee on that condition remains to be seen.

Willesborough (Kent).—The P.C. has requested the East Ashford R.D.C. to withhold consent to the application of the East Kent Electric Supply Co., Ltd., for a prov. order for E.L., so far as the parish is concerned, because only a portion of the district is scheduled in the area of supply.

Worthing.—The sub-Committee which was deputed to approach the various wiring contractors in the town with a view to the establishment of a mutual advertising scheme, proposes that electricity shall be supplied to those wiring contractors who are willing to co-operate in the matter and make a more elaborate display of electrical apparatus and fittings than they are able to provide at present, at the rate of 1d. per unit (subject to a definite maximum and minimum annual consumption being fixed in each individual case), and that arrangements be made with such wiring contractors for the issue and distribution of an official publication and for the display of a suitable illuminated tablet setting forth the Corporation charges, &c.

The T.C. is applying to the L.G.B. for sanction to a further loan of £2,700 to meet the probable requirements for house services and extension of mains during the next two years.

Ystradgynlais.—An electrical installation having been laid down to supply the town, the supply was switched on by Baron Cederstrom last week. The town was decorated for the occasion.

TRAMWAY and RAILWAY NOTES.

Astley.—With the opening up by the Pilkington Colliery Co. of a new colliery centre at Astley Green, it is stated that the South Lancashire Tramways Co. is to be asked to construct additional tramways through Leigh, Marsland Green and Astley, connecting at Leigh and at Boothstown with its system.

Australia.—MELBOURNE.—As the result of conferences representing the inner and outer groups of municipalities which are interested in the development of the metropolitan and suburban tramway services, a basis of representation on the Board of Control has been agreed on, and a complete scheme is to be submitted shortly.

Messrs. Noyes Bros. are reporting on a proposal for a tramway along the Dandenong Road, by the Councils of St. Kilda, Prahran, Malvern and Caulfield.

Birmingham.—The Corporation has decided to fit top covers to another 50 cars, and if the result is satisfactory, a further 80 cars will be so fitted, thus completing the equipment of the Corporation rolling stock.

Blackpool.—The B. of T. have sanctioned the borrowing of £4,300 for 15 years for the purchase of six new cars; these are to be of the "car-de-luxe" type.

Brierfield.—It is announced that the District Council has entered into a 14 years' agreement with the Burnley Corporation regarding the rental of the tramways, under which it will receive £150 a year more than has been the case during the past seven years. The Brierfield authority has also come to an arrangement with the Nelson T.C. for the supply of electricity upon reduced terms.

Burnley.—A report on the tramway tracks in several northern towns having been submitted by the tramways manager, the Tramways Committee has decided, subject to the approval of the Council, to have a system of "parallel running" at Burnley centre, and has instructed the borough engineer to prepare plans and an estimate of the cost, for relaying the new lines.

Continental Notes.—GERMANY.—Plans are being prepared in respect of a projected electric railway between Liebau and Schmiedeberg, Silesia.

RUSSIA.—The last of the new lines of electric tramways—about 3 miles in length—in the town of Kiew has just been completed and opened for traffic.

SWITZERLAND.—A decree has been granted to the Zurich-Oerlikon-Seebach Electric Tramway Co. to extend their lines from Oerlikon to Affoltern, near Zurich, and from Schwamendingen to Dübendorf. The total length of the line is about 10 miles, and the cost of the work is estimated at £39,640.—*Board of Trade Journal.*

ITALY.—An application for authorisation to construct and work two lines of electric tramways in the city of Pisa has been made by the Società Anonima Elettricità Toscana. As the Superior Council of Public Works has reported favourably on the scheme, the concession is expected to be accorded at an early date.

A tramway scheme to link Como with Erba Incino has been initiated by the Società Elettrica Comense A. Volta, who are now seeking official authorisation and a Government subsidy. The line will start from a junction with the existing Como urban tramway and finish at Incino-Erba, the length being 11·7 km.

La Società Generale Italiana Edison d'Elettricità has applied for a concession to build a tramway of normal gauge between Monza and Saronno. The line will have a length of 22 km., and will be worked by continuous current, the estimated cost of the permanent way, transmission lines and rolling stock being 1,150,900 lire.

The Government has granted a concession with the maximum subsidy for an electric railway to be constructed from Salerno to Amalfi, a distance of 20 km. The estimated cost is put at 5 million lire.—*Giornale dei Lavori Pubblici.*

Godstone.—The R.D.C. has decided to co-operate with other local bodies affected in dealing with the application of the Croydon and Southern Districts Railless Electric Traction Co. for power to run railless cars through the district to Caterham. The Council's surveyor has recommended that the application be objected to on the ground that the Council should be protected against extraordinary traffic on the roads.

Huddersfield.—The T.C. has decided to extend the tramway from its present terminus to Newsome Church, and the borough engineer has been authorised to carry out the work about April next. The estimated cost of the extension is £4,000.

Lancaster.—The T.C. has decided not to take any steps at present to acquire the undertaking from the tramway company, who thus continue for another seven years.

Little Hulton.—The South Lancashire Tramways Co. has notified the Tyldesley U.D.C. of its intention to proceed with an extension of its tramway system at Little Hulton.

Llanelly.—The Llanelly and District Lighting Co. has given the R.D.C. notice of its intention to extend the tramways to Felinfoel, Pwll and Llwynhendy.

Manchester.—In a general report to the Manchester Corporation Tramways Committee, Mr. McElroy, the manager, concluded that if the application for an eight-hour day were acceded to, and the men were paid the same weekly wages for 48 hours as they now received for 54, the total cost to the department would be £23,000, and consequently the annual contribution to the city fund in aid of the rates (£75,000) would have to be reduced by this amount. He admitted that the men were now doing more work than they did under the company, but their wages per hour had been considerably increased. He directed the attention of the Committee to the fact that several cities were paying higher maximum wages than were paid in Manchester. The hourly rates of drivers and conductors respectively, are: Under the London County Council, 7·8d. and 7·5d.; in Hull, 7·78d. and 6d.; in Sheffield, 7·4d. and 6·3d.; in Birmingham, 7·33d. and 6·66d.; in Glasgow, 7·11d and 7·11d.; and in Manchester, 7d. and 6·75d. If the application is granted, and the wages remain the same, the rates will be 7·87d. and 7·59d., so that they will then be higher than in any other tramway undertaking. Out of 20 cities, seven have fixed the working hours at nine per day, or 54 per week, the same as in Manchester. All the others have longer working hours, and none have adopted an eight-hour day. Since the Corporation took over the tramways, many concessions have been made to the

employés, and in the aggregate the cost to the department is £55,000 per annum.

The local branches of the Amalgamated Association of Tramway and Vehicle Workers replied on Tuesday to the Tramways Committee's refusal to grant an 8-hour working day for the drivers and conductors. They express willingness to submit the question to arbitration. The chief reason for the claim for an 8-hour day is, according to Alderman Jackson, the general secretary of the Association, that the men are now doing more work in nine hours than they had to do under the management of the old Manchester Carriage Co. when their hours were 10½.

Newmill (near Huddersfield). — The U.D.C. has decided to approach the Huddersfield Corporation with a request that the latter extend its tramway system from Honley to Newmill or Jackson Bridge.

Saddleworth (near Oldham). — The U.D.C. has appointed a committee to consider the details of a proposed Bill brought forward by the Railless Electric Traction Co. for providing Saddleworth and Springhead with a system of railless cars. The route suggested is from Roaches, by Greenfield to New Delph, from Springhead to Uppermill, and from Waterhead to Delph. It is estimated that by doing without rails the cost per mile will be reduced 90 per cent.

Worthing.—At a special meeting of the T.C., convened for the purpose on Tuesday, it was decided to refer the proposed Bill applying for Parliamentary sanction to install a system of electric tramways between Brighton and Worthing to the Parliamentary Committee of the Council for consideration and report, and in the meantime to present petitions to both Houses of Parliament alleging non-compliance with the Standing Orders. It was further decided definitely to oppose the Brighton, Hove and District Railless Traction Bill. Pending the report of the Parliamentary Committee on the details of the Bill, members refrained from expressing any opinion as to the advantages or otherwise which would accrue to the town from the introduction of electric trams into the borough, but the remarks made by Alderman White, the chairman of the Finance Committee, in introducing the other resolution, pointed to a decided opposition to the railless traction scheme. The promoters of the latter scheme, the Alderman observed, were practically proposing to introduce a system that had not hitherto been tried in this country, and they objected to the town being experimented upon in this way. Twenty-six of the twenty-seven members present voted for the resolutions respecting the tramway scheme, and the resolution to oppose the other scheme was unanimous.

TELEGRAPH and TELEPHONE NOTES.

International Telegraph Union Memorial.—The Swiss Federal Council has issued a revised programme for a competition for the erection of a monument at Berne to commemorate the foundation of the International Telegraph Union. None of the designs submitted for the competition, which took place last year, met with the approval of the international jury appointed to consider them. The new competition is open to all artists in the world. The artists chosen for the purpose will be entrusted with the execution of the monument, at a cost not exceeding 170,000 fr. The jury will have at their disposal the sum of 20,000 fr., to reward deserving competitors. Models must be deposited at the Federal Palace, Berne, before August 15th, 1911.

Multiple Telegraphy.—Experiments have been made at Florence with an apparatus invented by an Italian engineer named Andreini, in which vibrators of different frequencies are employed to transmit 10 to 15 messages simultaneously on one wire, the messages being sorted out at the receiving end by means of suitably-tuned receivers.

New Cable.—On January 1st the Anglo-Norwegian telegraph service was transferred to the British and Norwegian Governments, and a new cable, which has been laid between Newbiggin, in Northumberland, and Arendal, on the south coast of Norway, was opened for public use. The rate has been reduced from 3d. to 2½d. per word.

Russia.—The Russian Posts and Telegraphs Department is elaborating a project to establish next year wireless stations on the Tchukott peninsula to connect with Petropavlovsk and Nicolaieffsk; in Archangel for Solovietz and islands; in Reval for communication with ships sailing the Baltic; and, finally, at Taganrog for communication with vessels in that region. The wireless system is being extensively adopted in many other parts of Russia.—*Financier.*

Switzerland.— During a storm last week the international telegraph cable under Lake Constance was interrupted.

The *B. of T. Journal* states that in 1911 the Telegraph and Telephone Administration will expend on purchase of material and tools for construction and extension of lines, 4,166,000 fr.; telegraph and telephone apparatus, 1,129,000 fr.

Telephone Conference.—At the forthcoming conference of local authorities in Glasgow, the question of the measured rate will be revived, as it appears likely that the Government, after the transfer from the National Telephone Co., will bring all telephone users under this tariff. It is alleged that the measured-rate charges are unnecessarily high, and that the new conditions will retard the progress of telephony in this country.

Wireless Telegraphy.—It is reported that the ss. *Cedric*, fitted with new and powerful apparatus, has maintained communication with land throughout the crossing of the Atlantic, transmitting messages over a distance of 1,250 miles.

CONTRACTS OPEN and CLOSED.

OPEN.

Aldershot.—January 17th. 750 tons of steam coal, for the U.D.C. electricity works. See "Official Notices" December 30th.

Australia. — January 10th. Telephone cable, for the P.M.G.'s Department in Victoria. See "Official Notices" Nov. 18th.

January 10th.—Contacts and condensers, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 24th.—Wire, twisted pair, for the P.M.G.'s Department in Victoria. See "Official Notices" December 2nd.

January 25th.—Portable petrol-driven winch, for the P.M.G.'s Department in New South Wales. See "Official Notices" Dec. 2nd.

January 25th.—Insulators, wire, &c., for the P.M.G.'s Department in South Australia. See "Official Notices" December 2nd.

February 1st.—Testing equipment, for the P.M.G.'s Department in New South Wales. See "Official Notices" December 9th.

February 7th.—250 indicators, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 7th.—Eleven sections of a branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 14th.—Installation of wireless telegraphy at Thursday Island and Papua, for the P.M.G. of Australia. See "Official Notices" December 23rd.

April 18th.—One common-battery switchboard, for the P.M.G.'s Department in Western Australia. See "Official Notices" Dec. 23rd.

SYDNEY, January 16th.—Public Works Department. One hydro-electric generator, transmission line and pumping machinery in connection with the water supply to towns north of Wollongong.

January 30th.—State Railways. Two electrically-worked elevators, for the tramway repair-shops at Randwick.

February 21st.—29 miles of telegraph cable for P.M.G. Department, Victoria. See "Official Notices" to-day.

February 28th. One petrol-driven portable winch for P.M.G. department, Victoria. See "Official Notices" to-day.

Birmingham.—January 30th. Stores for the Corporation Tramways Department. See "Official Notices" Dec 30th.

Bootle.—January 18th. Two turbine pumps, electrically driven, for the Raleigh Street pumping station, for the T.C.; Borough Electrical Engineer, electric light station, Pine Grove.

Burnley.—Extensions at electricity works, installation of 1,000-KW. generating set. Mr. J. E. Starkie, electrical engineer, Electricity Works.

Cape Town.—March 1st. Tenders are invited for the installation of a system of ventilation, heating and cooling in the new Law Courts. See this column in our last issue.

Denmark. — January 16th. One 4,000-KW. turbo-generator, with condensing plant, for the municipality of Copenhagen. See "Official Notices" December 23rd.

January 12th.—Danish State Railways. 7,000 kilogrammes of telegraph wire, 13,000 zinc cylinders for electric batteries, 4,400 rolls of telegraph paper; and other lines. Specification can be seen at Board of Trade C.I. Branch, in London.

Haslingden.—January 10th. Electric lighting installation at the new infirmary, Higher Pike Law, Rawtenstall, for the B. of G. See "Official Notices" December 30th.

London. — ISLINGTON. — January 12th. High-tension switchboard for the Borough Council electricity works. See "Official Noticgs" November 25th.

January 10th.—High and low-tension switchgear. See "Official Notices" December 9th.

Manchester.—January 9th. The Tramways Committee invites tenders for special (permanent way) trackwork.

January 17th.—Tramway rail-bonds. Specifications, &c., from Mr. J. M. McElroy, general manager, Corporation tramways.

Morley.—January 16th. Materials for construction of about 1 mile 7 furlongs of single line of tramways with loops. See this column for last week.

Plymouth.—January 25th. Stores for a year, for the Corporation Electricity and Street Lighting Departments. See "Official Notices" to-day.

Portuguese West Africa.—March 25th. The municipal authorities of San Thomé, Portuguese West Africa, are inviting tenders for the concession for the establishment of a central generating station for the supply of electrical energy for lighting and power purposes in the town.

Richmond (Dublin).—January 18th. Joint Committee of the Richmond District Asylum wants tenders for the electric light fitting (Corporation supply) of Richmond Asylum buildings. Specifications, &c., Mr. T. Tomlinson, M.I.E.E., engineer, Northumberland House, Beresford Place, Dublin.

Salford.—January 16th. Steam-driven air-lift pumping plant, for the Corporation electricity works. See "Official Notices" December 16th.

Shanghai.—January 18th. Main H.T. switchboard and auxiliary switchgear for generating station; static transformers and high and low-tension switchgear for sub-station, for the Municipal Council. See "Official Notices" December 30th.

Sheffield.—January 21st. Stores, for the Corporation Tramways Department. See "Official Notices" to-day.

Shotley Bridge.—January 9th. Two high-speed engines and generators, switchboard, battery, and wiring for about 500 lights, at the new buildings on Whinney House Estate, for the Gateshead B. of G. See "Official Notices" December 23rd.

Spain.—The municipal authorities of Pueblo de Sanabbia (province of Zamora) have just invited tenders for the concession for the electric lighting of the town during a period of 25 years.

January 11th.—The Dirección General de Obras Públicas (Ministerio de Fomento) at Madrid invite tenders for an electric tramway between Catarroja and Silla (province of Valencia). Guarantee, 6,140.20 pesetas. Application has already been made by the Compañia General de Tranvias de Valencia.—*Annalen der Elektrotechnik.*

January 23rd.—The municipal authorities of Salamanca are inviting tenders for the concession for the electric lighting of the town during a period of 20 years. Tenders are to be sent to, and particulars may be obtained from, El Secretario del Ayuntamiento de Salamanca.

Sweden.—March 31st. The Wasserfalldirektion in Stockholm is inviting tenders for the supply of four turbines of 12,500 H.P. capacity.

Taunton.—2,500-volt single-pole switches and fuses, for the Corporation. See "Official Notices" December 23rd.

Todmorden.—January 11th. Wiring and fittings for the Town Hall, including conversion of gas chandeliers, for the Corporation. See "Official Notices" December 23rd.

Torquay.—January 11th. Electric light installation at Abbey Road Congregational Church. E. M. Skinner, The Glenkens, Warren Road, Torquay.

Turkey.—March 14th and 15th. The Ministry of Public Works are prepared to receive tenders for the following works:—(1) Construction of a generating station in the Vilayet of Constantinople; (2) construction of tramways and a generating station in the Sandjak of Adrianople. Tenders for the former must be delivered by March 14th, and for the latter by March 15th, at the Ministerial offices, where further particulars may be obtained.—*Der Elektrotechniker.*

Warrington.—January 10th. E.H.T. cable, for the Corporation Electricity Department. See "Official Notices" December 30th.

CLOSED.

Argentina.—An order has been placed with the firm of José Bernasconi & Co. for carrying out various electrical installations in the building now in course of erection as a residence for the President of the Republic. The cost is estimated at 294,730 pesos (about £25,800).—*Board of Trade Journal.*

Belgium.—Five concerns submitted tenders to the Société Nationale des Chemins de Fer Vicinaux, of Brussels, for the supply and erection of the overhead equipment of the branch electric railway between Laeken and Wemmel, the lowest being that of the Société Union-Electrique, of Brussels.

Chester.—The Tramways Committee has placed the following orders in connection with tramway-track maintenance:—

Five sets of points.—Messrs. Hadfields, Ltd.
Track girder, with drilling attachment.—Messrs. Geo. Robson & Co.

Derby.—The T.C. has accepted the tender of Messrs. Wm. Rickard, Ltd., for bitumen cable, at £100.

Leicester.—The Corporation Tramway Committee has accepted the tender of the United Electric Car Co., Ltd., of Preston, for fixing canopy-top covers to 19 cars, at £102 per car.

London.—BETHNAL GREEN.—The B.C. has accepted the quotation of the National Telephone Co., Ltd., to install telephones in the municipal buildings, at £74 12s. 6d.

Mexborough.—The U.D.C. has accepted the tender of Callender's Cable and Construction Co., Ltd., for cable, at £105 10s.; and that of the Royal Potteries Co. for one-way troughs at £16 1s. 8d., two-way £19 8s. 10d., and three-way £21 14s. 8d., per 1,000 two-feet lengths.

Morecambe.—The T.C. has accepted the tender of Messrs. Terry, Greaves & Co., of Wakefield, for coal for the electricity works.

FORTHCOMING EVENTS.

Institution of Civil Engineers (Students').—Friday, January 6th. At 8 p.m. "Measurement of Boiler Deformations," by Mr. G. F. Davidson.

Royal Institution.—Saturday, January 7th. At 3 p.m. Lecture, adapted to a juvenile auditory, on "Sound," by Prof. S. P. Thompson. (Lecture V, "Registration of Sounds.")
Tuesday, January 10th. Lecture, as above, on "Sound," by Prof. S. P. Thompson. (Lecture VI, "Reproduction of Sound.")

Association of Engineers-in-Charge.—Saturday, January 7th. At St. Bride's Institute, Bride Lane, E.C. Social. Dance.
Wednesday, January 11th. At 8 p.m. At St. Bride's Institute. Paper on "Engineering Plant in Institutions," by Mr. A. E. Wheeler.

Institution of Mechanical Engineers (Graduates' Association).—Monday, January 9th. At 8 p.m. Paper on "Air Movers," by Mr. G. L. Copping.

Institution of Electrical Engineers (Manchester Students' Section).—Tuesday, January 10th. At 7.30 p.m. At the Municipal School of Technology, Manchester. Paper on "Large Gas Engines," by Mr. G. D. L. Horsburgh.

Institution of Electrical Engineers (Glasgow Local Section).—Tuesday, January 10th. At 8 p.m. At 207, Bath Street, Glasgow. Ordinary meeting.

Institution of Electrical Engineers (Yorkshire Local Section).—Wednesday, January 11th. At 7 p.m. At the University, Leeds. Ordinary meeting.

University College, London.—Wednesday, January 11th. At 5 p.m. Course on "Advanced Electrical Measurements," by Prof. J. A. Fleming, F.R.S., begins.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, January 11th. At 7.30 p.m. At the University, Birmingham. Paper on "Merz-Price and other Discriminative Protective Apparatus for A.C. Circuits," by Messrs. K. Faye-Hansen and G. Harlow.

Junior Institution of Engineers.—Thursday, January 12th. At 7.30 p.m. At the Royal United Service Institution, Whitehall. Lecture on "Depreciation of Buildings and Machinery," by Mr. H. F. Donaldson, C.B., Chief Superintendent, Royal Ordnance Factories.

Institution of Electrical Engineers.—Thursday, January 12th. At 8 p.m. At the Institution Building, Embankment, W.C. Adjourned discussion on Major W. A. J. O'Meara's paper on "Submarine Cables for Long-Distance Telephone Circuits."

Westminster Technical Institute (L.C.C.). Vincent Square, S.W.—Friday, January 13th. At 7.30 p.m. First of a course of six weekly lectures on "Illumination," by Mr. J. S. Dow.

Manchester Association of Engineers.—Saturday, January 14th. Paper on "Condensing Plant," by Mr. W. A. Dexter.

NOTES.

The Aisgill Disaster.—Commenting on the recent accident to the Scotch express, the *Railway Times* says:—

"Only one thing would have prevented the accident, and that is 'lock-and-block,' but, as usually installed, it is doubtful whether the presence of the light engines on the down line would have locked the block instrument, because this movement was one of many, and the lock would probably have been off. But had track-circuiting been installed, the presence of the light engines would have absolutely prevented the home signal being lowered. It is due to the Midland Co. to say that, along with the other large lines—the South-Western and Great Eastern excepted—they have not seen their way to install lock-and-block. They are, however, believers in track-circuits, and since, within the last few years, these have been proved to be effectual and reliable, they have put down many lengths, and, as has been said, had track-circuits been in use at Hawes Junction, the accident could not have happened. . . . . The outbreak of fire is the saddest part of the business, and here something may be done. The use of gas, though it is convenient, cheap, and satisfactory as a light if the inverted incandescent mantles are used, has proved a danger on more than one previous occasion. The adoption of electricity seems very desirable. While steel coaches might offer some advantages they are at best a questionable improvement, and are not likely to be generally adopted, but something might be done to render the carriages less easily inflammable, and to secure uniformity in their weight, so as to diminish the liability of telescoping."

We are pleased to see that the advantages of track signalling, and the dangers of gas, which we pointed out last week, have received the attention of our railway contemporary also.

[We regret that, by a slip, we named the *Railway Engineer* instead of the *Railway Times* in a leaderette in this issue, which went to press before the error was noticed. Our apologies are due to both of our contemporaries.]

Royal Institution.—The following Friday evening meetings are announced by this Institution:—

January 20th.—Prof. Sir James Dewar, F.R.S., &c., "Chemical Change at Low Temperatures."
January 27th.—Prof. W. H. Bragg, F.R.S., &c., "Radioactivity as a Kinetic Theory of a Fourth State of Matter."
March 31st.—Prof. H. S. Hele-Shaw, F.R.S., &c., on "Travelling at High Speeds on the Surface of the Earth and Above It."
April 7th.—Prof Sir J. J. Thomson, F.R.S., &c., "A New Method of Chemical Analysis."

There will also be six Saturday afternoon lectures by Sir J. J. Thomson on "Radiant Energy and Matter," the dates being March 4th, 11th, 18th, 25th, and April 1st and 8th.

It is announced that the ventilation of the Lecture Room is now carried out by the use of two large electrically-driven exhaust injector fans.

Electric Steel.—Messrs. Lake & Elliot, Ltd., of Chapel Hill, Braintree, on Saturday completed the installation of an electrical steel foundry. The furnace is capable of melting 2½ tons of metal every four hours.

Glasgow Exhibition, 1911.—According to a daily paper, arrangements for this important Exhibition are beginning to take definite shape on a site of 50 acres in Kelvingrove Park, within a mile of the centre of the city. "A large amount of space has been set apart for the exhibition of electrical apparatus and appliances, and general machinery of all kinds, in a special building to be called the Kelvin Hall. The object of the Committee in charge of this department of the Exhibition is to illustrate the progress of electrical and engineering discovery and invention, and the development of electricity as an applied science."

Cable Repair Staff Drowned.—We regret to read that among the passengers on the missing steamer *Axim*, part of the wreckage of which has been found, there are four men who were bound for Teneriffe to carry on cable repair operations. Their names are given as follows:—Richard Malt, Charles Cakebread, Robert Keys and Richard Schwartz.

British Coalite.—Sir Wm. Preece told shareholders of the British Coalite Co., Ltd., last week, at their meeting in London, that his confidence in the undertaking was as strong as ever it was. He added, according to the *Times* report, that important negotiations were in progress which materially affected the shareholders' interests generally, and after giving the matter careful consideration, the directors had decided that it would be inadvisable to make any statement with regard to them at the present time. The meeting was therefore adjourned until March 30th.

Appointments Vacant.—Fitter for the Works Department of the Blackpool Tower Co., Ltd,; junior assistant engineers, for the Yorkshire Electric Power Co., Ltd. (£26); clerk (30s.), first, second and third shift engineers (35s., 30s. and 27s.) and cable jointer (38s.), for the Aberdare U.D.C.; technical assistant, for the Stoke-on-Trent Corporation Electricity Department (30s.). The New Zealand Government is advertising for an electrical engineer for public works (£800); a shift engineer is required for Gillingham Electricity Department (27s. 6d.). See our advertisement pages in this issue.

Tramcar Stopping Places.—A Brixton resident was summoned on Monday by the L.C.C., under its Tramways Act of 1900, for wilfully doing an act to certain apparatus used in connection with the working of an electric tramcar, calculated to obstruct or interfere with the working of such carriage. The grievance of the defendant was that the driver of the car on which he was travelling failed to pull up at the next stopping place after he had rung the bell. He, therefore, knocked the "breaker" out, with the result that, current being cut off, the car came to a standstill. Defendant said that drivers constantly refused to stop at the stopping places, and his action was really taken as a protest in the public interest. He said that the driver and conductor had been heard to say that, as they were late, they would have to rush the stopping places. The magistrate—who, under the Act, might have imposed a penalty up to £20—ordered defendant to pay one of £2 and the costs of the summons.

Cathode Ray Telephotography.—The greatest drawback in connection with telephotography is the inertia of the selenium cell or other photo-electric element used in the transmission of luminous impressions. Cathode rays, owing to the instantaneousness of their electromagnetic deflection, allow a telephotographic receiver free from any inertia to be constructed.

The following scheme has been recently suggested by two German inventors, Messrs. Dieckmann and Glage*: A bundle of cathode rays is limited by a diaphragm pierced with a fine hole, through which only a thin pencil of rays is allowed to pass. The style of the transmitter throws into four electromagnets, two current components acting on the beam of light so as to cause it to perform the same movements as the style simultaneously with the latter. The beam of light thus sets up in some convenient substance, such as chalk, a fluorescence producing in the observer's eye the impression of a continual line of light, which comprises the various positions of the luminous point. A few seconds are thus sufficient to reproduce in the receiver any signals or hand-written words. In connection with the transmitter the motion of the style is decomposed into two components converted into current intensities, which expendient has long been used in telautography.

The following modification of the same process is more convenient for practical purposes. A small dynamo connected to a voltage regulator produces currents exciting the electromagnets, so as to cause the beams of light continually to perform a vertical alternate motion, each individual movement entailing a small lateral displacement. In this way the luminous point, in about ·1 second, searches a square of 3 cm. × 3 cm. As each luminous impression lasts beyond the actual duration of the impulse, the eye sees a luminous square made up of individual instantaneous impulses.

The transmitter likewise comprises a square of 3 cm. × 3 cm., searched in succession by minute metal brushes synchronously with the square of the receiver, the time required for completing the search of the square likewise being of ·1 second only. A battery is connected on one hand to the metal brushes and on the other, through the line to two electromagnetic coils, the working of which is explained in the following:

A small metal pattern destined to be made visible at the receiving station is connected in front of the transmitter square, through the telegraph line, to the other terminals of the electromagnetic coils. Thus the minute brushes will search in succession the various parts of the metal pattern, closing each time the line-current through the electromagnetic coils. The latter accordingly deflect the cathode rays already in front of the diaphragm so as to cause the luminous point on the screen to disappear at each current closure. At each contact between the brushes and the metal pattern at the transmitting station all the spots corresponding to contacts in the transmitter square, thus appear black in the receiver, a silhouette of the pattern appearing on the luminous square.

As the luminous spot, after searching in $\frac{1}{10}$ second the whole of 9 square cm., again begins the same motion, the silhouette of the pattern on the receiver square will follow accurately and continuously any motion performed by the pattern of the transmitter. According to this arrangement ·0002 second suffices for producing one picture element.

The process above described is the only one in connection with which the time of production of luminous spots can be reduced sufficiently for the first luminous impression not yet to have vanished by the time the whole surface has been searched, thus producing the illusion of a continuous image. Moreover, this is the only method allowing the image at the receiving station to follow any movement of the pattern at the transmitting station instantaneously and synchronously. In order to eliminate any disturbance due to lengthy transmission lines, the inventor intends utilising electromagnetic waves for the transmission of luminous impressions.

* "Zeitschrift für Schwachstromtechnik," No. 22, 1910.

Institution Notes.—ASSOCIATION OF MINING ELECTRICAL ENGINEERS.—The discussion on Mr. R. R. Smith's paper was resumed at the Newcastle branch on December 21st.

Mr. Barber said that it was not possible to have a man doing nothing else but inspecting. He should be able to do any repairs required, and, to save time, a small store should be established at the shaft bottom.

Mr. Fisher supported the proposal to have one man on inspection duty only. There might be 12 miles of roads to inspect, and a man would not cover the distance in a reasonable time if he had to stop frequently to carry out repairs and adjustments. The regulations call for daily examination of certain parts of an installation, and he had found it advisable to draw up a programme under which the whole of his plant was inspected at specified intervals.

Mr. Milburn suggested that in lighting systems having the neutral earthed, it was advisable to have the leads armoured or run in tubing. The perfect insulation of lighting circuits was specially important, because profuse lighting generally meant that the locality was much frequented. Branch circuits run in piping would make the leakage indicator give a false indication owing to capacity. He thought that coal-cutter motors should be capable of being switched straight on the mains, thus dispensing with starting gear.

Mr. Fisher mentioned that he had a large number of squirrel-cage motors working very successfully, but where the rush of current at starting was objected to, it was necessary to install special motors, such as the cascade type made by the Sandycroft Foundry Co. To prevent accidents to men working on cables, he had the first joint box on every cable, in the form of an oil-immersed disconnecting box, and the man put the links into his pocket before proceeding with the repair. In his opinion the same precaution should be taken on any circuit at over 100 volts pressure.

Mr. Clothier did not think it advisable to depend upon oil for insulation. He thought that a definite air-gap should be introduced.

Mr. Sheaver said that all high-tension switching and earthing should be done only by authorised persons. He also drew attention to the need of carefully distinguishing between the various incoming and outgoing feeders in the event of giving verbal instructions.

Constantinople Tramway and Lighting Concessions.—Supplementing the announcement published a week ago respecting the approval of an agreement for the conversion of the system of the Constantinople Tramways Co. to electric traction, a German correspondent in the Turkish capital states that the two chief points in dispute concerned the expropriation of the land for the widening of the streets and the amount of the "bridge money" to be paid to the City Prefecture for the passage of the tramcars over the new Golden Horn Bridge. Both the Government and the tramway company have agreed that the municipality has to bear the cost of the expropriation of land, but the requisite funds will be placed at the disposal of the latter by the tramway company at a low rate of interest, and this loan will be repaid out of the city's share in the tramway net profits. An agreement has also been arrived at in regard to the money to be paid for the privilege of crossing the bridge, although the exact amount has not transpired. At first the Municipal Council demanded an annual payment of £T7,200, whereas the company was only willing to pay £T2,600. The tramway company, which is controlled by the international enterprise known as the Union Ottoman, hopes to be able to begin the electrical working of the tramways in two years, as the new rails, with the exception of the Galata-Serail-Shischli section, are already laid. The relations between the tramway company and the firms of Ganz & Co., of Buda-Pesth, and Fouquiau, of Paris, who have secured the concession for the electric lighting of Constantinople, should turn out, in the opinion of the correspondent to be interesting. In order to obtain the privilege, the firms have

been compelled to make large concessions, so that the electric lighting undertaking would only be able with difficulty to become profitable, especially as the tramway company has the right of lighting its own routes. It is added as being the general opinion in Constantinople that both undertakings should work in combination, particularly in regard to the erection of the electricity works.

"Fire Boxes" or Frictional Igniters.—The taxes on matches on the Continent have brought the recently introduced mechanical igniters into considerable prominence. In principle these are simply up-to-date modifications of the old flint and steel tinder boxes. Instead of the flint stone a cerium alloy is employed which produces a plentiful shower of sparks when lightly struck, while the tinder is replaced by a wick soaked in benzine. One very handy form is so arranged that pressure on a button causes the lid to fly open, and at the same time a small piece of the special alloy fixed in the lid strikes against a piece of steel, and the sparks thus produced ignite the wick. A suitable alloy was patented some years ago by Auer (D. R.-P. 154,807), composed of cerium with about 30 per cent. of iron added. Metallic cerium is produced by the electrolysis of a fused compound. In the pure state it is too soft to produce any sparks, and is also too readily oxidised, but the cerium-iron alloy ("Auermetal") is considerably harder, less affected by the atmosphere, and is readily filed, turned and planed. In order to prevent ignition during manufacture, it is necessary to keep the surface coated with petroleum, and the chips and filings must also be quenched in petroleum or water for safety.

Some makers prefer to use a cerium-magnesium alloy containing about 12 per cent. of magnesium. This also sparks readily, but hardly withstands the action of the atmosphere so well. Alloys of cerium with silicon, boron and titanium are also said to have the property. The exact reason for this ignition property is not yet determined, but it is essential that the particles struck off shall be very small, and that their ignition temperature shall be low so as to enable the small amount of energy available to bring them to the glowing point. To ensure the smallness of the particles the metal must be hard. Recently Auer has suggested that the property may depend on the formation of low oxides of cerium at the surface, and that their formation is favoured by the presence of the iron in the alloy.

"Auermetal" is manufactured at Treibach, in Austria, and at Köln-Luidenthal, in the form of blocks weighing 5 or 6 lb., and also in strips 12 mm. wide and 2 or 3 mm. thick. The selling price is about £5 12s. per lb., whilst the cost of manufacture is said to be only about 18s. per lb. In use the alloy is gradually worn away, but so slowly that it has to be replaced only after several thousand strikings. Several forms of the apparatus are also manufactured for use with gas burners. In one such arrangement the turning of the gas tap automatically produces a shower of sparks which ignites the gas.—*E.T.Z.*

Electricity in Oil Production.—At the meeting of the Baku branch of the Imperial Russian Technical Society, recently, says the *Financial News*, Mr. I. Pilkevitch (a Russian mining engineer) read an interesting paper on "The Comparative Value of Steam and Electricity in Reclaiming Oil," a question of the utmost importance to those interested in oil production. The history of the application of electrical energy to oil production dates from 1901, but the new method had not been widely adopted until the Russian Electric Power Co. started its large power stations at Bailoff and Belygorod. In 1907 the total amount of oil baled by electrically-driven machinery reached 62,200,000 poods; in 1908, 80,600,000 poods; and in 1909, 95,900,000 poods, from which it will be seen that the application of electric energy to oil production is growing from year to year. The experiments conducted by Mr. Krassin (a mining engineer) in the oilfields of the Caspian and Black Sea Oil Co. have shown that the expenditure of electric power on each 1,000 poods of oil reclaimed amounted to 188-320 KW.-hours, according to the efficiency of the baling machinery. Mr. Pilkevitch places the figure at 453 KW.-hours. The average price of electric energy during 1907-9 was 9·4 kopecks per KW.-hour. This makes the maximum cost of production 42·58 roubles per 1,000 poods. Now, during the same period the average expenditure of oil fuel in reclaiming oil by steam-driven machinery was 154 poods per 1,000 poods, valued at the average market price of oil for the period (27·5 kopecks per pood), at 42·05 roubles. Taking into account that the working expenses and repairs of steam engines are much higher than those of electric motors, it becomes obvious that in oil production electric power is much more economical than steam power. At present 23 oil-producing firms in the Baku area alone are working their baling machinery by electricity.

A German Electric Motor Ambulance.—The Daimler Motoren Gesellschaft, of Marienfelde, Berlin, has recently completed an electric motor ambulance for the municipal authorities of Rixdorf, a town near the German capital. Outwardly, the vehicle resembles a petrol car, the space under the bonnet in which the engine is usually placed being occupied by a battery of Hagen accumulators, having a capacity of 195 ampere-hours, sufficient for a run of 35 to 40 miles on one charge. The electric motors, of 10 H.P. each, are built in the hubs of the rear wheels. The controller is adapted to give four forward speeds, a reverse motion and three braking positions. The body of the ambulance, which was built at the Kuhlstein Carriage Works at Charlottenburg, has accommodation for two patients in a reclining position, and hinged seats for three attendants, as well as all the necessary equipment to render first aid to the injured.

Ludw. Loewe & Co., Ltd.—We are asked to state that the liquidation of Ludw. Loewe & Co., Ltd., which is an independent English company, does not in any way affect the Berlin company, which is in a very prosperous condition. The English company is being wound up for purely private reasons, and Mr. G. Goodchild, who has been managing director for more than five years, and who is acting as sole liquidator, will continue the business under his own name on the same lines, and at the same address (Farringdon Road, E.C.), as soon as the liquidation is completed.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. P. J. PRINGLE, late of Burton-upon-Trent, recently arrived at Melbourne, Australia, and proceeded at once to take up his appointment as general manager and engineer of the Electric Supply Co. of Victoria, Ltd. The company is controlled by a board of directors in this country. Mr. Pringle will be responsible to the company for the general management of their electric light, power and tramway undertakings in the city of Ballarat, which is situated some 75 miles from Melbourne, and in the city of Bendigo, which is situated some 70 miles from Ballarat. He will also act as consulting engineer of the electrical undertaking at Koolgardie, Western Australia. The capital of the company is nearly half-a-million, and it at present operates some 22½ outer miles of track with some 54 cars, which include 18 trailers. There is at present a good demand for lighting, and a certain amount of power, and it is anticipated that there is considerable work to be done in this direction. Mr. Pringle will be resident at Ballarat, which is a very beautiful city, healthily situated on the slopes of the Australian Alps, some 1,500 ft. above the sea level. The city is styled the "Garden City of Victoria," owing to the beautiful manner in which it is planned.

The Electricity Committee of the Aston Manor T.C. recommended that the salary of MR. FOSTER, electrical engineer, be increased from £500 to £600 per annum, and the Council on Wednesday approved.

MR. WITTEY, of Walthamstow, has been appointed to the position of installation engineer by the Tynemouth Corporation.

MR. DUNCAN MACLENNAN, A.M.I.E.E., Glasgow, has been appointed burgh electrical engineer for Oban. There were 171 applicants for the post.

Tramway Officials.—MR. J. E. MALLINSON, of Blackpool, has now been appointed chief engineer to the Burmah Electric Lighting and Tramway Co., Mandalay.

General.—MR. W. S. WILSON has resigned his position as outside manager of the electrical department of Messrs. Clarke, Chapman & Co., Ltd., to take up the position of branch manager for Messrs. Johnson & Phillips, Ltd., at 44B, Blackett Street, Newcastle-on-Tyne. (Telephone No. Central 1,691.)

MR. HORACE BOOT, owing to increased professional business, has removed from Great George Street to Westminster Chambers, 7, Victoria Street, S.W.

MR. T. H. ROBERTS-WRAY, who has been with Messrs. Crompton and Co. as chief representative for eight or nine years, has now severed his connection with that company, and has started on his own account as consulting and inspecting engineer at 15, Leadenhall Street, E.C. We understand that Mr. Wray has had a varied experience in marine and general engineering work, and particularly in regard to the requirements of the British Admiralty and foreign Governments.

MR. H. J. HOHNE wishes to announce to his friends in the trade that he is resigning his position as London manager to Messrs. Gent & Co., Ltd., which post he has held for the past six years. He is joining Messrs. Reid Bros. (Engineers), Ltd., 12, Wharf Road, City Road, as their sales manager.

Obituary.—MR. S. S. DICKENSON, the vice-president and general superintendent of the Commercial Cable Co., died in New York on December 23rd of an obscure ailment causing impoverishment of blood. The deceased gentleman, who was born at Plymouth, England, in 1852, began his career as a telegraphist in England in 1867, and he has been identified with submarine cable interests for many years. Mr. Dickenson was in the Direct United States service at Torbay for 10 years, and in 1884 he joined the Commercial Co. and established a cable station at Canso, of which he was superintendent for 20 years, during which period he made it a model of efficiency, while he also in the meantime undertook important work for the same interests in other parts of the world. In 1900 he established the Commercial Cable station at the Azores, opening up the first cable communication between Portugal, the Azores, and North America. In this connection he was decorated by the late King Carlos. In 1901 Mr. Dickenson selected landing places for the Commercial Pacific cables at Honolulu, Midway, Guam, and Manila, and supervised the construction of

stations. In January, 1904, he was appointed general superintendent of the Commercial Cable Co., and shortly thereafter he was made a member of the board of directors and vice-president. He was also a director of the Commercial Pacific Co. We believe that no telegraph man was better known or more esteemed throughout the entire cable and telegraph service. He is described as a man of noble character, great ability and tact, an expert electrician, while as a manager of men he was unexcelled. He did much to perfect duplex working on cables. Mr. Dickenson was a member of the Institution of Electrical Engineers and of the American Institute of Electrical Engineers. As a mark of respect to his memory, all Commercial and Commercial Pacific circuits were silenced for a few minutes during the funeral services, which were attended by many cable and telegraph officials and other employés and friends. The interment took places at Antigonish, Nova Scotia, on 28th ult.

MR. H. C. LEAKE.—A correspondent writes that the death occurred at Brighton on December 29th of Mr. Henry Cook Leake, who was recently appointed chief electrical engineer to the Chilian Navy. The deceased gentleman, who was in his 38th year, was lately head of the electrical department at Devonport Dockyard.

MR. A. W. RICHARDSON.—We regret to learn that Mr. A. W. Richardson, of Patricroft, passed away on December 23rd, in his 71st year. Deceased, who was born in the U.S.A., came to England at an early age, and started a small engineering works in London. Later, he went to Manchester, joining Messrs. Crossley Brothers, Ltd., and remaining there during the period when they started making gas engines. Next he again engaged in business as a machine tool maker, and some of his tools then made are still in use. In 1881 he turned his attention to arc lighting and to dynamo construction, and in collaboration with the late Mr. Charles Lever brought out the "Lever" arc lamp, which was used in the lighting of several electrical exhibitions about that time. He later evolved the Richardson arc lamp, and lamps bearing his name are used in many engineering works throughout the kingdom. Two years ago he carried out an installation for Mr. P. H. Coats, of Paisley, for growing plants under the light of specially-designed electric arc lamps. We are asked to state that the business of "A. W. Richardson, Skew Bridge Works, Patricroft," will be continued by the deceased gentleman's son, Mr. Chas. W. Richardson, who has been closely connected with it for some years past.

NEW COMPANIES REGISTERED.

Twin-Grips, Ltd.—(113,411).—This company was registered on December 23rd, with a capital of £2,000 in £1 shares (1,500 preferred and 500 deferred), to carry on the business of electricians, engineers, suppliers of electricity, &c., and to acquire from H. E. Evans a patent for an invention relating to an electrical fitting. The subscribers (with one preferred share each) are:—A. F. Howard, 33, Lime Street, E.C., merchant; P. C. Austwick, 423, Birkbeck Bank Chambers, W.C., electrical engineer. Private company. The directors are to number not less than three or more than five. H. E. Evans is one of the first and may retain office while holding 100 shares. Registered office, 63, Bishopsgate Street Within, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Nairobi Electric Power and Lighting Co., Ltd. (87,728).—Issue on December 14th of £1,000 debentures, part of a series of which particulars have already been filed.

Richardsons, Westgarth & Co., Ltd. (67,599).—Return dated December 10th, 1910. Capital £700,000 in £1 shares (350,000 preference and 350,000 ordinary). All shares taken up. £700,000 paid. Mortgages and charges: £350,000.

Amazon Telegraph Co., Ltd. (44,532).—Return dated December 13th, 1910. Capital £250,000 in £10 shares. All shares taken up. £250,000 paid. Mortgages and charges: £300,000.

Taunton Electric Traction Co., Ltd. (76,319).—Particulars of £5,000 debentures, created November 21st, 1910, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £3,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Sheerness and District Electric Power and Traction Co., Ltd. (65,749).—Particulars of a series of debentures, created March 7th, 1905, to secure half the issued capital for the time being, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £900. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees. (The share capital for the time being is £75,000.)

Coatbridge and Airdrie Electric Supply Co., Ltd. (89,178).—Further charge on company's undertaking and property, present and future, including Coatbridge and Airdrie undertakings, and all rights, powers and interests of the mortgagees as undertakers of the orders in connection with such undertakings, dated December 8th, 1910, to secure £3,700. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, E.C.

Cowans, Ltd. (57,378).—Debenture dated December 8th, 1910, to secure £300, charged on the company's property, present and future, including uncalled capital. Holder: E. A. M. Bindloss, 49, Fountain Road, Edgbaston.

CITY NOTES.

Electro-Chemistry in Switzerland.

THE report of the Elektrizitatswerk Lonza, of Basle, which refers to the financial year ended with June, 1910, deals with another unfavourable period, as the deficit of £18,900 brought forward from 1908-9 has been increased to £48,000 in 1909-10, on a share capital of £480,000 and loan capital of £360,000. It is pointed out by the directors that the unfavourable conditions in the manufacture of carbide of calcium, and the decline in sale prices, became aggravated during the year, and the same observation applied to the market for ferro-silicon, which also suffered with the carbide market from over-production. As a consequence, the manufacturing profits on two of the company's principal branches were reduced by more than one-half, although it has recently been possible to reduce the prime costs. In addition to these circumstances, the undertakings in which the Lonza Co. is interested yielded less favourable results. The situation has, however, improved since the close of the financial year on June 30th, 1910. The crisis in various allied branches (the aluminium industry, for instance), of which the company had felt the reaction, now seems to have been overcome; whilst an alteration in the general situation of business, which directly affected the company, has taken place. The international understanding between producers of carbide has been brought into existence for almost all the European works, and a considerable improvement in prices has taken place. The hope is, therefore, expressed that the situation of the market will soon recover, if not in the present financial year—which still suffers from the effects of the cutting prices—at least in the succeeding financial year. It is added that the prospects of a similar understanding in the ferro-silicon trade have been improving for some time past, and are hoped to restore equilibrium also in this market.

Sao Paulo Tramway, Light and Power Co.—Warrants for the quarterly dividend of 10 per cent. per annum were to be posted on 31st inst.

Aron Electricity Meter, Ltd.—At an extraordinary general meeting held at Winchester House, E.C., on December 29th, Mr. H. Hirst presiding, a resolution was passed increasing the capital by £100,000 (in £1 ordinary shares) to £350,000. The chairman referred to the growth of the company's meter trade, and to the absorption of a great deal of their capital in the taximeter business; a number of subsidiary companies had been started in other countries.

British Power Co., Ltd.—The report of this company, according to the *Financier*, states that during the year to June 30th the board used their utmost endeavours to place upon a more satisfactory footing for realisation the remaining undeveloped assets of the company. As soon as the Fife Electric Power Co. has settled with its bankers certain loans incurred some years ago, the shares in the new Fife Tramway, Light and Power Co., Ltd., will be issued to this company in exchange for its present holding. The directors are advised that the new company is doing a satisfactory business. To enable the necessary finance to be procured for the Llanelly and District Electric Lighting and Traction Co., Ltd., the directors have agreed to accept deferred ordinary shares in place of the ordinary shares held, and the prospects of that company are now looking far more favourable. The directors hope to be able shortly to announce the completion of the arrangements to place in a strong financial position the Nottinghamshire and Derbyshire Tramways and the Derbyshire and Nottinghamshire Power Co., which should materially improve the value of this company's holding in those companies. On the other hand, the board have recently, with regret, had to agree to accept ordinary shares of a very greatly reduced face value in place of this company's considerable holding of deferred shares in the Cleveland and Durham Electric Power, Ltd., which, although ranking in advance of the shares previously held, still represent a considerable loss. The remaining assets of the company call for no special comment, but there seems to be a slightly improved prospect for British electrical enterprises.

Dawlish Electric Light and Power Co., Ltd.—A statutory meeting was held on Monday, Mr. C. N. Lovely, M.D., presiding. The chairman gave the history of the development of the scheme from 1903, when the Urban Council of the town, in a fit of enthusiasm, acquired a provisional order, but eventually parted with it to Crompton & Co. As a result of a conference between representatives of the company and a number of enterprising residents, it was decided to float a company. It was shown that a capital of between £5,000 and £6,000 was ample to establish electric light works, but to allow a margin for extension the company was registered with a capital of £10,000. It was resolved not to proceed unless £4,000 was taken up. Crompton & Co. had taken £1,500 shares, and the remaining sum required had been subscribed, enabling the directors to go ahead. After much unavoidable delay they were now able to report substantial progress. They had obtained the permission of the Board of Trade to use overhead wires, thus effecting a considerable saving in the original estimated cost, and the difficulty of the site had been got over, suitable ground having been secured in Brook Street, at a cost of £650, the site including a block of cottages. Plans of the generating station would be submitted to the Council at their next meeting. The chairman added that 76 persons had taken up shares in the company. The engineer, replying to questions, said the electric light should be ready some time in May.

MARKET QUOTATIONS.

Wednesday, January 4th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
, Hydrochloric	per cwt.	5/-	..
a " Nitric	"	22/-	..
a " Oxalic	"	28/-	..
a " Sulphuric	"	5/6	..
a Ammoniac, Sal	"	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	..
a " "	"	£30	..
a Bleaching powder	"	£5 10	..
a Bisulphide of Carbon	"	£18	..
a Borax	"	£16	..
a Ferro-Silicon (50 %)	"	£9 10	..
a Copper Sulphate	"	£18	..
a Lead, Nitrate	"	£25	..
a " White Sugar	"	£22 15	..
a " Peroxide	"	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a " Chlorate	per lb.	8½d.	..
a " Perchlorate	"	4½d.	..
a Potassium, Cyanide	"	7d.	..
a Shellac	per cwt.	80/-	5/- dec.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	"	£6 10	..
a " Recovered	"	£6 10	..
a " Lump	"	£5	..
a Soda, Caustic (white 70 %) ..	"	£11	..
a " Chlorate	per lb.	8½d.	..
a " Crystals	per ton	£8 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
a " Cyanide (basis 100 %) ..	"	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£80	..
b " Wire, in ton lots ..	"	£112	..
b " Sheet, in ton lots ..	"	£120	..
p Babbitt's metal ingots	"	£38 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	6¼d.	..
c " Tube (brazed)	"	8¼d.	..
c " " (solid drawn) ..	"	7d.	..
c " Wire, basis	"	6¼d.	..
c Copper Tubes (brazed)	"	9d.	..
c " " (solid drawn ..	"	8¾d.	..
g " Bars (best selected) ..	per ton	£71	£1 dec.
g " Sheet	"	£71	£1 dec.
g " Rod	"	£71	£1 dec.
e " (Electrolytic) Bars ..	"	£69	£1 dec.
e " " Sheets ..	"	£75	£1 dec.
e " " Rod ..	"	£62 15	£1 dec.
e " " H.C. Wire	per lb.	7¾d.	¼d. dec.
f Ebonite Rod	"	6/-	..
f " Sheet	"	5/6	..
n German Silver Wire	"	1/11	..
h Gutta-percha, fine	"	8/6	..
h India-rubber, Para fine	"	5/4	¼d. dec.
l Iron Pig (Cleveland warrants) ..	per ton	50/-	1d. inc.
l " Wire, galv. No. 8, P.O. qual.	"	£14	..
g Lead, English Ingot	"	£13 5 to £13 10	5/- dec.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£8	..
d Mica (in original cases) small ..	per lb.	6d. to 1s.	..
d " " " medium	"	2/6 to 4/-	..
d " " " large ..	"	4/6 to 8/6	..
p Phosphor Bronze, plain castings	"	11d.	..
p " " rolled bars & rods	"	1/0½	..
p " " rolled strip & sheet	"	1/1	..
o Platinum	per oz.	160/-	..
c Silicium Bronze Wire	per lb.	8¼d.	¼d. dec.
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	"	£180 to £181	£8 inc.
n " Wire, Nos. 1 to 16	per lb.	2/-	¼d. inc.
p White Anti-friction Metals ..	per ton	£45 to £150	..
A Zinc, Sh't (Vieille Montagne bnd.)	"	£29 15	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Power-Gas Corporation, Ltd.—The directors' report for the year to September 30th last (as given in the *Financial News*), states that the results of the year's trading of Ashmore, Benson, Pease & Co., show a total profit of £5,878, to which has been added the balance brought forward from last year's account, £3,174, making altogether £9,052. Of this, £2,700 has been transferred to reserve, £4,000 to the accounts of the Power-Gas Corporation for dividend, and the balance, £2,352, carried forward to the next account. The results of the year's trading of the Power-Gas Corporation show a total profit of £8,016, to which has been added £5,690 brought forward from last year's account, making altogether £13,706, which the directors propose to apply as follows:—To reserve fund, £1,600; to dividend at 4 per cent. per annum upon the ordinary shares, £9,984; balance carried forward, £2,122.

Rio de Janeiro Tramway, Light and Power Co., Ltd.—According to a financial daily the directors are, for the purpose of providing funds in connection with the extension works in Rio, and for other purposes of the company, at present offering for subscription, by the existing shareholders, the balance remaining unissued of the share capital of the company, namely, 28,750 shares of $100 each. A dividend of 1¼ per cent. is announced.

STOCKS AND SHARES.

Tuesday Evening.

STOCK EXCHANGE markets have yet to recover fully from the effects of the Christmas and New Year holidays, so that although 1911 starts with a good volume of business, the accumulation of orders over a long week-end is in itself sufficient reason for the increased activity this Tuesday. The movements of prices in the electricity departments during the past fortnight have been trifling, and it may be permissible to linger, for a column, over the prospects that front the various sections of the electrical markets during the New Year.

The great temptation in writing a forward review is to ascend into unqualified optimism, just as the tendency of a retrospective article is to descend into gentle melancholy. To guard against the former is, at all events, essential, and if the cheerful man thinks that the opinions expressed are too sober, he must make allowance for them on this score.

In the case of the supply shares, the outlook is not too bright at present. Although in the autumn it began to look as though the companies in London would be able to show good results for the current six months, later statistics demonstrate that the lean period must be expected to last for some while longer. A few of the companies will have moderately satisfactory figures to lay before their proprietors, but the others are marching very slowly, and the transition stage enforced by the metal-filament lamp is still here.

To prophesy half a year ahead is a particularly gratuitous form of folly, yet as regards electricity supply shares, it is sane to suppose that another six months should see the companies reaping the reward of their somewhat unhappy experiences, and the share quotations beginning to reflect a better condition for the industry.

The Telegraph market, apart from the speculative issues, has a powerful investment backing which serves as an admirable buttress against any but serious attacks. That is, it does not suffer particularly in turns of dear-money spasms, political problems at home and abroad, and such similar extrinsic factors. Cheap money naturally has a helping influence, inasmuch as it drives public attention to search for good securities of all kinds, and placid politics are valuable for every market. The only fault on the line, so far as can be foreseen now, is the development of wireless telegraphy, which has passed out of the experimental stage in which it gave the prices of cable shares so sharp a shock, and which is every day proving its potentialities as well as its existing uses. This is a matter which cannot be ignored by the investor. On the other hand, the leading cable companies are mostly in a position of great financial strength, are ably managed, and, presumably, are not likely to remain stationary as this new adjunct to the business is making its presence felt so obviously and publicly.

It is to the Latin-Canadian group that the speculative investor will turn most eager attention this year, because the various companies have already lived down most of the doubt which assailed their earlier days. The result is transparent in the very substantial rises which have occurred in most of the stocks and shares since they came to the London market. But London has not a monopoly in their favour. The canny Scot is a regular "collector" of these investments. Edinburgh and Glasgow Trust companies, insurance, banking and other financial corporations, have bought big blocks, especially of the prior-charge bonds, and although the cautious Scotsman is proverbially given to taking big risks when it comes to investment, in the case of the Canadian-Mexican-South American issues, his purchases are tempered with inside knowledge and practical acquaintance with the business. Investors are alive to the opportunities offered for the employment of capital by progressive countries and progressive industries. They are willing to take reasonable risks of the natural phenomena in the tropics and elsewhere, and in view of the earnings which the companies under discussion exhibit, we are disposed to think that the New Year has further advances in store for the stocks and shares in this market.

Fortune's smile has for so a time refused to shine upon the older electrical railway stocks, that it would seem as though this very fact must be a bull point, indicating a change in the ensuing twelvemonth. Moreover, there is the Coronation near at hand, and a brilliant season for all classes in London society. There are other minor considerations that favour the idea of a better time for the Tube Railways, and such benefit would naturally be to the advantage of the electrified lines as well. It may happen that 1911 will see a decided impetus given to electrification of parts of the older companies' systems, since the raising of fresh capital is pretty sure to become far less difficult than has been the case for the past half-decade. The revival in Home Railway stocks will, if continued, give the companies that chance of getting money for developments, on reasonable terms, which they have been deprived of for so long, and it is no secret that several of the big companies are anxious to push along with electrification schemes. This ought to provide much work for the manufacturing undertakings, which, by the way, are not at all likely to be hampered by rubber rising again to the fancy prices reached last spring. Good authorities talk rubber between 5s. and 6s. per lb. this year, with occasional fall and rise above those figures, but they scout the idea of the raw material going to anything like 13s. per lb. again, for a very long time to come.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1907.	1908.	1909.	1910.	Closing Quotations Dec. 27th.	Closing Quotations Jan. 3rd.	Business done week ended Jan. 3rd, 1911. Highest	Lowest.	Rise + or Fall —	Present Yield per cen £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	5⅜ — 6⅛	5⅜ — 6⅛	..	..	..	Nil.
286,500	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	..	98½—100¼	96 — 98 xd	..	..	..	5 2 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	..	146 —148	144 —146 xd	..	..	..	5 9 7
$58,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	..	95 — 97	93 — 95 xd	..	..	..	4 4 8
558,460	Anglo-American Telegraph	Stock	3½%	£3 4s.	3⅜%	..	70½— 72½	71 — 73	70	..	+ ½	4 19 4
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	..	114 —116	114½—116½	115⅞	114½	+ ⅛	5 3 0
3,220,770	Do. do. do. Deferred	Stock	1 %	8/-	25/-	..	28⅜— 29½	28½— 29	29	28 15/16	— ¼	4 6 2
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	..	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	7 — 7¼	7 — 7½	7 7/32	..	..	5 10 4
2,449,176	Commercial Cable, Stlng. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	..	85 — 87	84 — 86 xd	85⅜	..	..	4 13 0
16,000	Cuba Telegraph	10	6 %	6 %	6 %	..	8⅝— 9⅜	8⅝— 9⅝	..	..	..	6 11 6
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	16½— 17½	16½— 17½	..	..	..	5 16 9
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅝— 3¾	3⅝— 3¾	..	..	..	5 1 7
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	..	8½— 8⅝	8½— 8⅝	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	..	101½—103½	99 —101 xd	..	..	..	4 9 1
60,710	Direct United States Cable	20	4½%	4½%	4 %	..	15⅝— 16⅛	15⅝— 16⅛	15⅝	..	..	5 1 7
	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	..	101 —103	99 —101 xd	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	135 —138	135 —138	136½	135	..	5 1 5
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	..	83 — 85	83 — 85	84⅜	..	..	4 2 4
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	..	99½—101½	99½—101½	100	99½	..	3 18 10
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	12⅞— 13⅛	12⅝— 13⅜	13½	12⅝	+ ⅛	5 6 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	100 —102	100 —102	..	..	..	3 18 5
200,000	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	99½—101½	99½—101½	..	..	..	3 18 10
181,127	Globe Telegraph and Trust	10	5⅔%	5⅔%	5⅔%	..	10½— 10⅔	10½— 10⅔	10⅝	10 5/8	..	5 9 5
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13⅜— 13⅝	13⅜— 13⅝	13⅜	13½	+ ⅛	4 8 1
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	18 %	18 %	..	31 — 32	31½— 32½	..	..	+ ½	5 10 9
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	..	53 — 55	53 — 55	54½	..	..	5 18 7
$41,380,400	Mackay Companies Common	$100	4 %	4 %	4½%	..	92 — 94	92 — 94	..	..	..	4 9 6
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	..	76 — 78	76 — 78	..	..	..	5 0 0
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	3/16— 3/32	3/16— 3/32	13/6	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	1/- — 1	1/- — 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	31/32— 32/32	32/32— 33/32	13/6	..	..	5 11 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	..	106 —107	106½—107½	106⅜	..	+ ⅜	5 11 10
3,725,000	Do. do. Def. Stock	100	6 %	6 %	6 %	..	127½—129½	128 —130	129¼	128½	+ ¼	4 12 4
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	..	10⅜— 10⅝	10⅜— 10⅝	..	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	..	10¼— 10⅝	10⅜— 10⅝	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	..	5⅞— 5 11/16	5⅝— 5⅞	..	..	+ 1/16	4 7 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	..	99 —101	97½— 99½ xd	..	..	..	3 10 4
1,983,593	Do. do. 4 % Deb. Stock Red.. ..	100	4 %	4 %	4 %	..	99 —101	97½— 99½ xd	..	..	..	4 0 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	8 %	8 %	8 %	..	1 3/16— 1 1/4	1 3/16— 1 1/4	..	..	..	4 14 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 5/16— 1 3/8	1 5/16— 1 3/8	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	..	88½— 90½	86¼— 88½ xd	..	..	..	4 10 5
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	..	99 —101	97 — 99 xd	..	..	..	4 0 10
11,839	Reuter's	8	5 %	5 %	5 %	..	7½ — 8	7½ — 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	..	98 —100	96 — 98 xd	..	..	..	4 11 10
3,042	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	132 —135	132 —135	..	..	..	4 8 11
120,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7¼— 7½	7¼— 7⅝ xd	7 5/16	..	..	5 7 7
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5⅛— 5¼	5⅛— 5⅜ xd	..	..	..	4 6 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1 3/16— 1 1/8	1 3/16— 1 1/8	2/-	..	..	4 8 11
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	..	99 —101	97 — 99 xd	97½	..	..	4 0 10
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13½— 14	13½— 14 xd	13⅝	13⅜	..	4 17 5
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	101—103	100 —102 xd	..	..	..	3 18 5
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	1¾— 1 15/16	1¾— 2⅛	42/6	28/6	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	..	9⅝— 10	9⅛— 10	..	..	..	6 0 0
4,669	Do. do. 6 % Cum. 2nd Pref.	10	£2 6	15 %	14½%	..	8¾— 9¼	8⅞— 9½	..	..	..	6 9 9
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	..	102 —104	100 —102 xd	..	..	..	4 18 10

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	5 %	..	4 13/16— 5 1/16	4¾— 5 xd	100/-	96/8	..	5 0 0
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	5 %	..	4 1/16— 4 1/8	4 5/16— 4 3/8 xd	91/10½	88/1½	..	5 6 8
4,465,674	Do. 4 % Deb. Stock	Stock	..	4 %	4 %	..	92 — 93½	91 — 93 xd	93½	91½	..	4 6 0
332,387	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	..	101 —104	101 —103 xd	..	..	..	4 17 1
880,000	Babcock & Wilcox, 1 to 530,000	1	20 %	20 %	24 %	..	5⅜— 5⅞	5⅜— 5⅞	5 13/16	5⅞	..	4 2 7
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1⅜— 1½	1⅜— 1½	..	..	..	4 0 0
1,000,000	British Aluminium 5 % Mort. Debs. Red.	100	..	..	..	..	..	..	..	..	..	5 10 4
500,000	British Columbia E. Rail Def. Ord. Stock	100	8 %	8 %	8 %	..	146 —150	142½—145½ xd	144½	144	..	5 6 8
400,000	Do. Pref. Ord. Stock	100	5 %	6 %	6 %	..	123 —127	123 —127	126⅝	125½	..	4 14 6
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	110½—113½	111 —114	115⅝	112⅝	+ ⅛	4 8 1
233,000	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	..	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	..	102 —105	102 —105	..	..	..	4 5 9
133,301	British Electric Traction	10	Nil	Nil	Nil	..	¾ — 1⅛	1 — 1½	25/-	20/6	+ ⅛	Nil
161,437	Do. do. 6 % Cum. Pref.	10	3 %	1½%	Nil	..	3½— 3 13/16	3½— 4	77/6	73/9	..	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	89 — 93	89 — 93	91	89½	..	5 7 6
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	..	74 — 79	74 — 79	..	..	..	5 12 6
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	..	6⅜— 7½	6⅜— 7½	..	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5⅜— 6	5⅜— 6	..	..	..	5 0 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	..	101 —104	99 —102 xd	..	..	..	4 8 3
201,579	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	..	98 —101	98 —101	..	..	..	4 9 1
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	..	½ — ⅝	½ — ⅝	..	..	..	Nil
1,316,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	..	59 — 62	57 — 60 xd	..	..	..	6 13 4
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	3/16— 1/4	3/16— 1/4	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref... ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	..	37 — 42	37 — 42	..	..	..	10 14 4
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	..	23 — 27	21 — 25 xd	..	..	..	18 0 0
137,610	Calcutta Trams, 1 to 137,610	5	6 %	4½%	4½%	..	4⅜— 5	4⅜— 5	96/3	..	..	4 10 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	5 %	5 %	5 %	..	4⅜— 5⅛	4⅜— 5 xd	..	..	..	5 0 0
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	..	98 —101	98 —101	98½	..	..	4 9 1
35,000	Callender's Cable Construction shares	5	15 %	15 %	10 %	..	9⅛— 9⅜	9⅛— 9⅜	..	..	..	5 3 3
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4 13/16— 5 1/16	4 13/16— 5 1/16	..	..	..	4 18 9
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	..	102 —104	102 —104	102	..	..	4 6 7
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	..	13/32— 15/32	15/32— 17/32	9/3	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	12 %	12½%	17½%	..	3 — 3¼	3⅜ — 3½	61/6	61/-	..	5 8 2
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4 %	4½%	..	105 —108	105 —108	..	..	..	4 3 4
1,890,690	Central London Railway, Ord. Stock	Stock	3 %	3½%	3 %	..	64 — 65	63 — 65	64½	63½	..	4 12 4
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	..	85 — 87	85 — 87	..	..	..	4 12 0
554,655	Do. do. Def. do.	Stock	2 %	2½%	2 %	..	44 — 46	44 — 46	..	..	..	4 7 0
1,480,000	City and South London Railway	Stock	2½%	1½%	1½%	..	26 — 27	28⅜— 29⅛	29	28¼	+ 2/8	5 18 8
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	— ⅛	Nil
100,000	Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	..	83 — 86	77 — 82 xd	..	..	..	6 1 11

* Unless otherwise stated, all shares are fully paid.

‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Dec. 27th.	Closing Quotations Jan. 3rd.	Business done week ended Jan. 3rd, 1911.		Rise + or Fall —	Present Yield per cent.
		*	1907.	1908.	1909.	1910.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	6 %	5 %	..	⅞ — 1	⅞ — 1	..	..	..	5 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1 1/16	1 — 1	..	..	— 1/16	6 0 0
271,030	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	98 —101	97 —100 xd	..	..	..	4 10 0
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	..	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½%	Nil	Nil	..	0 — ¼	0 — ¼	..	..	..	Nil
17,189	Do. "A" shares, 01—017,189	5	2½%	Nil	Nil	..	1 — 1½	1 — 1½	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	63 — 68	61 — 66 xd	..	..	..	6 1 3
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	..	77 — 80	77 — 80	..	..	..	6 5 0
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1⅝ — 1⅞	1⅝ — 1⅞	..	..	..	7 9 4
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	8¼ — 8⅝	8 — 8¼ xd	..	..	..	5 17 8
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	..	80 — 84	80 — 84	..	..	..	4 15 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	½%	Nil	Nil	..	¾ — 1	¾ — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10⅞ — 10⅞	10⅞ — 10⅞	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 —103¾	102 —103¾	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	..	12½ — 13	12½ — 12⅝	12½	12½	— ½	5 17 8
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5⅛ — 5 5/16	5⅛ — 5 5/16	..	..	..	5 4 8
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	..	107 —109	107 —109	..	..	..	4 3 4
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	..	15⅝ — 16½	15 — 15⅝ xd	15⅝	15⅝	..	6 7 0
37,500	†Liverpool Overhead Railway, Ord.	10	½%	Nil	Nil	..	1 1/16 — 1 3/16	1 1/16 — 1 3/16	..	..	..	Nil
1,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 15 7
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	Nil	..	..	1¼ — 2⅛	1¼ — 2⅛	..	..	..	Nil
299,930	Do. do. 60,008 to 100,000	10	3 %	Nil	..	..	1¼ — 2⅛	1¼ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	3⅜%	Nil	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	..
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	..	67 — 71	65 — 69 xd	..	..	..	5 15 11
5,732,062	Metropolitan Consolidated	100	1½%	1½%	1 %	..	39½ — 40	40⅜ — 41¼	41⅜	40¼	+1¼	2 8 6
2,640,914	Do. Surplus Lands	100	2⅜%	2⅜%	2⅜%	..	64 — 66	64 — 66	65⅛	64⅜	..	4 3 4
3,235,000	Do. District	100	Nil	Nil	Nil	..	26¾ — 27¼	27⅛ — 28	27⅜	26⅝	+3⅛	Nil
391,397	Metropolitan Electric Trams., Ord.	1	..	4½%	5%	..	⅜ — ⅝	⅜ — ⅝	..	..	..	5 14 3
814,016	Do. do. Defd.	1	Nil	Nil	..	..	1/16 — ⅛	1/16 — ⅛	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	15/16 — 1 1/16	15/16 — 1 1/16	17/9	17/6	..	5 6 8
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	..	99 —101	98 —100 xd	..	..	..	4 10 0
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	6 %	..	122¼—123¼	123 —12	124½	..	+ ½	4 16 0
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	..	5 %	..	96½ — 97½	96⅛ — 97⅛	97	96⅛	..	5 2 7
245,500	Potteries Electric Traction	1	4 %	Nil	..	..	1/16 — 3/16	1/16 — 3/16	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	⅜ — ½	⅜ — ½	..	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	80 — 83	80 — 83	..	..	..	5 8 5
87,350	Telegraph Construction and Maintenance	12	17½%	15 %	17½%	..	38 — 40	38 — 40	39½	39	..	5 9 5
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	..	101¼—103½	99 —101 xd	..	..	..	3 19 3
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	..	5 %	..	101 —102	101 —102	101⅜	101⅜	..	4 18 0
2,800,000	Do. do. 4½ % Bonds	..	..	..	4½%	..	95 — 97	93 — 95 xd	96¼	94	..	4 14 9
4,900,000	Do. do. 6 % Income Bonds	..	..	..	..	..	38 — 40	38 — 40	38⅞	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	10 %	5 %	Nil	..	⅝ — ¾	⅝ — ¾	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	6 %	3 %	..	1 — 1⅛	1 — 1⅛	..	..	..	10 0 0
245,495	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	..	55 — 65	55 — 65	..	..	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

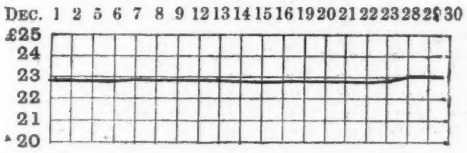
30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 15 7
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	6⅞ — 7⅛	6¾ — 7⅛	..	..	..	4 14 11
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	..	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	5 19 5
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4¼ — 4⅜	4¼ — 4⅜	..	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	3⅞ — 4¼	3⅞ — 4¼xd	78/9	..	..	5 7 6
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	95 — 97	95 — 97 xd	96⅞	96¼	..	4 2 6
9,436	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	..	3⅛ — 3⅜	3⅛ — 3⅜	70/-	..	..	6 4 2
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	..	97 — 99	97 — 99	..	..	..	4 10 11
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	7 %	..	11 — 11⅛	11 — 11⅜	11 5/8	11¼	..	6 1 9
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	11⅞ — 12⅜	11⅞ — 12¼	12⅜	..	..	4 16 0
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	..	120 —124	118 —122 xd	..	..	..	4 2 0
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	..	99½—102½	98 —101 xd	..	..	..	4 9 1
50,000	County of Durham Electrical Power, Ord.	5	2 %	Nil	Nil	..	1½ — 2	1½ — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	2⅝ — 3⅜	2⅝ — 3⅜	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	5 %	5 %	..	94½ — 96½	92 — 94 xd	..	..	..	5 6 5
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	..	7⅜ — 7⅝	7⅜ — 7⅝	..	..	..	6 7 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	10½ — 11	10⅝ — 11	10 13/16	10⅝	..	5 9 1
400,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	..	104½—107½	104 —107 xd	106	105	..	4 4 1
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	..	98 —101	98 —101	..	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	⅝ — ¾	⅝ — ¾	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	Nil	Nil	Nil	..	1½ — 2	1½ — 2	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	..	74 — 77	74 — 77	..	..	..	5 16 11
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	5 %	5 %	..	81 — 83	81 — 83	81⅞	81¾	..	6 0 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	..	4½ — 4⅝	4½ — 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	..	4½ — 5⅛	4½ — 5⅛	..	..	..	4 11 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	..	99 —102	99 —102	..	..	..	4 8 3
15,000	Hove, 1 to 15,000	5	8½%	8½%	8½%	..	6⅝ — 7⅛	6⅝ — 7⅛	6 13/16	..	..	5 19 4
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	5 %	5 %	..	103½—105½	101 —103 xd	..	..	..	4 17 1
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	8 %	8 %	..	6⅝ — 7	6⅝ — 7	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	..	93 — 95	93 — 95	..	..	..	4 4 3
11,000	London Electric Supply Corporation, Limited, Ord.	3	2 %	3 %	2 %	..	1⅜ — 1⅝	1⅜ — 1⅝	3 1/9	..	..	3 8 1
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4¼ — 5⅛	4¼ — 5⅛	..	..	..	5 17 1
862,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	..	89 — 92	89 — 92	..	..	..	4 7 0
200,000	Metropolitan Electric Supply, 1 to 100,000	5	6½%	5 %	5 %	..	3½ — 3⅝	3½ — 3⅝	..	..	..	6 13 4
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	..	4¼ — 4⅜	4 — 4¼xd	70/-	..	..	5 5 11
235,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4 %	4½%	4½%	..	102 —105	100 —103 xd	..	..	..	4 7 5
248,000	Do. 3¼ % Mort. Deben. Stock Redem.	Stock	3¼%	3¼%	3¼%	..	83 — 86	82 — 85 xd	..	..	..	4 1 5
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	..	87⅞ — 88⅞	86 — 87 xd	88½	..	..	5 14 11
13,685,000	Do. Light and Power Co., Ltd., Common	$100	4 %	3¾%	4 %	..	88½ — 90½	8-½ — 90½	89½	..	..	4 8 5
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	7 %	7 %	..	104½—106½	105 —107	106½	105¾	+ ½	6 10 10
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	5 %	5 %	..	92¼ — 93½	92½ — 93½	93⅝	93	+ ¼	5 6 11
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4 %	4½%	4½%	..	97 — 99	95 — 97 xd	..	..	..	4 12 9
180,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	2½%	..	..	3⅜ — 4¼	3⅜ — 4¼	..	..	..	2 12 9
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	..	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
150,000	{North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500}	100	..	..	5 %	..	97½ — 99½	97½ — 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7 %	..	..	11½ — 12½	11⅛ — 12½	..	..	..	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	..	6¼ — 6⅝	6¼ — 6⅝	..	..	..	5 3 8
119,694	River Plate Elcty. Co. Ord.	Stock	6 %	8 %	9 %	..	228 —238	228 —238	..	..	..	3 15 8
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	..	103 —113	103 —113	..	..	..	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	..	100½—102½	98 —100 xd	..	..	..	5 0 0
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	..	7¼ — 7⅜	7¼ — 7⅜	..	..	..	6 9 0
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	..	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	4 0 6
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	..	86 — 88	85 — 87 xd	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	..	..	1½ — 2	1½ — 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	4 %	5 %	5 %	..	2⅜ — 3	2⅜ — 3⅛	..	..	+ ⅛	6 7 0
180,100	Do. do. 5 % 1st Mort. Deb.	100	..	5 %	5 %	..	100 —103	97½—100⅝xd	..	..	..	4 19 6
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	..	..	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	..	1⅝ — 1 3/16	1⅝ — 1 3/16	..	..	..	6 16 7
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	..	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	..	..	¾ — 1	¾ — 1	..	..	..	20 0 0
60,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	2 — 2¼	2 — 2¼	..	..	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	..	80 — 83	80 — 83	..	..	..	5 8 5
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	5 %	..	..	⅛ — ⅜	⅛ — ⅜	..	..	..	5 14 3
100,000	Westminster Electric Supply, Ord.	5	10 %	10 %	10 %	..	⅞ — 7⅞	7⅞ — 7⅞	7⅞	7⅞	+ ⅛	6 10 1
51,370	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	..	— 5⅛	4⅞ — 5⅛xd	..	..	..	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

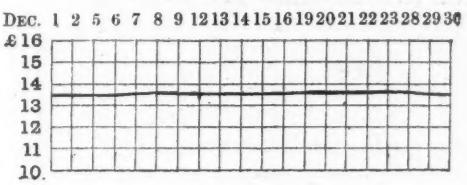
METAL MARKET.

Fluctuations in December.

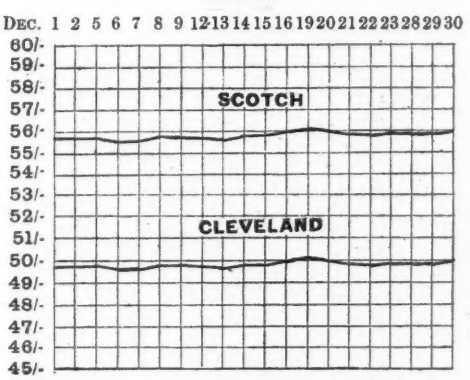
SPELTER (G.O.B's.).



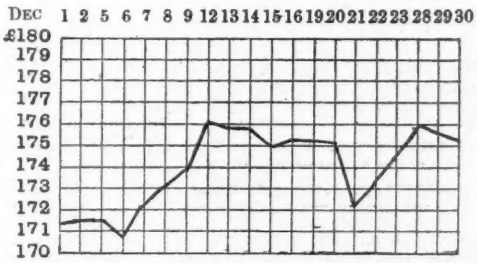
LEAD (ENGLISH).



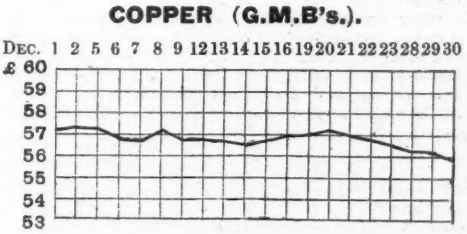
IRON.



TIN.



COPPER (G.M.B's.).



Staff Dinner.—On Tuesday last week the annual dinner of the staff of MESSRS. DUNCAN, WATSON & CO. was held at the Holborn Restaurant. Mr. Duncan Watson presided, and amongst those present were several of the chairman's fellow-members on the Marylebone Borough Council. Including ladies, some 150 sat down. Mr. A. Blythen, in proposing the health of the chairman, referred to the success that had attended the latter's efforts in building up the business during the last 10 years. The chairman proposed "The Staff," and Mr. H. S. Walker replied.

PROCEEDINGS OF INSTITUTIONS.

Recent Progress in Mining Switchgear.

By GEORGE STEVENSON, A.M.Inst.C.E.

(*Abstract of Paper read before the* MINING INSTITUTE OF SCOTLAND, *at Glasgow, December 21st*, 1910.)

ARCING depends almost entirely on the self-induction of the circuit, and, within limits, the resistance is of lesser importance. The writer would emphasise this point, because there appears to be a certain amount of confusion in mining circles as to the cause of arcing, and experiments based on resistance measurements only are of little value. It is very probable, for example, that the resulting spark, due to breaking the field-magnet circuit of a continuous-current dynamo, may be more violent, more dangerous to life, and cause more damage than the breaking of the main circuit of the same machine. Yet in the one case the current is only a few amperes and the resistance is very high, while in the other the current may reach hundreds of amperes and the resistance be quite low. But the electro-magnetic inertia, or self-induction, of the field-magnet system, is enormous as compared with that of the main circuit. Hence in breaking such circuits special precautions have to be taken.

The first requisite in an electrical switch is that it should be mechanical. By this is meant that there must be no perishable or fragile materials, such as untreated wood, slate, marble, asbestos, rubber, or presspahn used in its construction.

In the case of small lighting circuits, single-pole switches are as a rule sufficient. In power work, however, double-pole or triple-pole types are used, depending on whether the circuit is continuous current or three-phase alternating. Considered from the standpoint of switchgear, the latter system is undoubtedly to be preferred for mining conditions.

The oil-break type is now used to the exclusion of all others. In its simplest form it consists of three sets of contacts, by which the circuit is made or broken under oil contained in a surrounding vessel. When the switch is connected up to cables of the armoured type, special provision is made for the solid bonding of the armouring by means of cable-boxes bolted direct to the framework of the switch. This is a feature of the utmost importance in mining work, and one which cannot too strongly be insisted upon. Another feature of equal importance is the protection of the operator from accidental contact with "live" parts of the gear.

The present tendency to adopt a multiplicity of automatic features in mining switchgear is, in the writer's view, not to be commended. It is much better to reduce the number of attachments to the lowest possible limit, and to endeavour to secure the utmost simplicity throughout. For this reason two-coil overload trips are in general quite sufficient, except when the neutral point of the system is "earthed," when it becomes necessary to adopt three-coil trips, in order to ensure adequate protection. It is preferable to engage a good man, and pay him a good wage, rather than to rely on too many automatic contrivances. The foregoing remarks are intended to refer specially to underground apparatus.

To sum up the matter, it may be stated that the cardinal points in the lay-out of mining switchgear, arranged in order of their importance, are (1) safety, (2) reliability, (3) simplicity. These desirable features can all be secured by suitable designs of oil-immersed ironclad switchgear.

Oil for use in switches, particularly at high voltages, requires special care in selection and handling. Oil tanks should be thoroughly dried before being filled, as even a very small percentage of moisture is deleterious.

In the case of switchgear for use on the surface in main power stations and sub-stations, it is desirable to adhere to the cardinal points outlined for underground apparatus. The conditions, however, are somewhat different, for the switches are, as a rule, of much greater capacity, and more space is available for their installation. In the case of 500-volt circuits, the construction found suitable for ordinary industrial conditions may also be used for mining work. Well-designed boards built of substantial slate panels, mounted on an iron framework, and so arranged as to keep all "live" metal away from the front of the board, make quite a satisfactory equipment. It is essential, however, to pay particular attention to the workmanship throughout, especially at the back of the board, and to leave ample space for inspection. In fact, the best way of judging the merits of the board is to inspect the back, and to pay less attention to the front.

In the case of circuits above 500 volts, an entire departure from the above construction is necessary, in order to secure the maximum of safety and reliability. The most satisfactory solution is to enclose each item of the equipment in a separate and self-contained fireproof cell constructed of moulded stone. Absolute security and safety to the attendant is obtained by means of double interlocking.

It is essential that the oil-break switches on the main station switchboard should have, irrespective of their carrying capacity, a rupturing capacity such that it would be capable of dealing safely with the maximum short-circuit current on the generator-plant. A dead short-circuit on a feeder circuit in the main station may be opened by the feeder-switch before the generator-switch has time to open, and, in this case, unless the feeder-switch has sufficient rupturing capacity, it may be severely damaged, although the fault may be cleared by the switch on the generator-panel.

In conclusion, the writer would like to insist upon the necessity of safety, simplicity, and reliability, in the design and construction of mining switchgear. Simplicity is the acme of good design, and

the number of instruments and subsidiary devices should be reduced to the lowest possible limit. Reliable apparatus is of the first importance, and in this connection it should be borne in mind that colliery managers are restricted by Act of Parliament to an eight-hour day, the actual time for winding being something less than this. Therefore the initial cost of first-class gear will very soon be defrayed when the saving due to uninterrupted operation is taken into account.

Sufficient attention has not been given in the past, in collieries generally, to the question of switchgear, with the result that low initial cost has been the determining factor in the class of switchgear installed. Happily the urgent necessity of raising the standard in this direction is now being recognised.

Electric Winders.

(*Discussion at Newcastle Local Section of the* INSTITUTION OF ELECTRICAL ENGINEERS, *continued. See* ELECTRICAL REVIEW, *December 9th.*)

ON December 12th MR. T. C. FUTERS reopened the discussion with a description of the various systems of winding, and gave details of some of the outstanding problems met with in the design of winders generally. In his opinion absolute safety came first, and cost second. The more simple electric winders could be made, the more they would appeal to the colliery engineer. At present an electric winder cost more than a steam one, and the cost of working was undoubtedly higher. A weak point about the argument that electric winders were a great success in Germany was that in all cases Koepe pulleys had been adopted, with their inherent drawbacks. To make any sort of a show with electric winders, it was essential to get rid of the inertia of the usual design of rope drum. He showed lantern slides illustrating various forms of winding gears, with and without balance ropes, and also a diagram of the work performed by a winding engine during a complete cycle of operations. In theory the use of a spiral drum got over many difficulties, but the cost was excessive, and there was always difficulty when dealing with multiple-deck cages. At the Grand Hornu Mine, where there was a very excellent three-phase winder, hydraulic keps were used, and these undoubtedly accounted for the success of the installation. The difficulty in winder design was not so much in balancing the ropes as in balancing the inertia of the winding drum, and if this could not be done, could it be removed or reduced? The ideal was to utilise the inertia of the drum towards the end of the wind, but this took time, and it was essential to get the tubs in and out of the pit in the minimum time, even if it cost a little more. It might, however, be remarked that the chief difficulty was not in winding the coal out of the pit, but in getting it from the face to the bottom of the shaft. Taking two extreme cases, to wind 2,000 tons from a 1,000-ft. shaft in 10 hours required 271 H.P. winding 1 ton at a time, but 250 H.P. winding 8 tons at a time with simultaneous decking. Even in these widely varying cases there was a saving of 21 H.P. only. The most economical system was to wind the maximum net load at the lowest speed possible. Ropes with a breaking strain of 350 tons could now be supplied. For an 800-yd. shaft such a rope would weigh 17 tons, and allowing a factor of safety of 10, the permissible net safe load would be 8 tons, after taking the acceleration stresses into account. It was usual to make the drums 100 to 120 times the diameter of the rope, but with modern flexible ropes this could be considerably reduced. As a solution to the difficulty of balancing the inertia of the drums, he had designed a system in which the two drums were geared to each other and were driven by independent motors. Each drum was provided with balance weights to which it could be clutched as required. With regard to the question of taking an outside supply or generating on the spot, he was of opinion that if the necessary capital was available, and the load factor favourable, it was cheaper to generate on the spot, and the working of the Eight Hours Act tended in this direction.

MR. FRANK ANSLOW (Walter Dixon & Co., Glasgow, communicated) thought that condensing winding engines were hard to beat for efficiency, and it should be remembered that one conversion of energy only was necessary, *i.e.*, under the boilers. In any case, the margin of cost was very small. His firm had recently designed a plant in which a high-speed steam engine was direct-coupled to a generator which supplied power for ordinary purposes. On the same shaft, through a disconnecting coupling, were also mounted a heavy fly-wheel and two variable-voltage generators for supplying power to two hoists which had the same load characteristics as winders. The two hoists working together resulted in a peak load of 900 H.P., which with a load of 300 H.P. on the other generator, making a total of 1,200 H.P., was quite easily met by an engine having a normal output of about 450 H.P. The necessary regulating apparatus was simple and reliable.

MR. M. R. KIRBY was then called upon, and in reply, he said that one of the main points in the consideration of the installation of either steam or electric winding engines, after the prime necessity of safety, was the cost of working the winder. It would be of advantage to point out actual costs obtained on some fairly modern winding engines operated by steam; he gave some particulars concerning two winding engines—one at the Bowburn Colliery and the other at Park Pit. The winding engine at Bowburn Colliery was a cross-compound non-condensing engine, working at 150 lb. per sq. in. without superheat. The cylinders were 13¾ in. × 23 in. × 32 in. and the drum 8 ft. in diameter. There was a balance rope. The depth of the shaft was 636·6 ft., and two tubs containing about 10 cwt. each were wound in each cage. The engine made the lift in 25 to 27 sec. (27 sec. was the designed time), and the tubs were changed in about 5 sec.; 100 tons could be raised per hour. Particulars of the cost of winding were given. During the period over which the figures were taken, the coal raised per hour (24 hours per day) was 20·28 tons. In arriving at the cost of boilers to be charged to winding, 30 per cent. of the total cost was taken, it having been found that the engine used rather less than 30 per cent. of the total steam used. This engine was put down in July, 1907.

	Cost, pence per hour.	Cost per ton per 1,000 ft.
Boilers and steam pipes to main stop valve (power). Capital charges, 10 per cent. of £720	1·97d.	
Labour	2·124d.	
Coals	9·69d.	
Stores and repairs	·205d.*	
Total	13·989d.	1·084d.
Winding Engine.		
Capital, 10 per cent. of £2,110	5·78d.	
Labour	10·76d.	
Stores and repairs	·87d.	
Total	17·41d.	1·35d.
Gross cost		2·434d.

The costs are based on the following details:—

CAPITAL COST OF BOILERS, &C.

Two Adamson boilers	£950
Green economiser	309
Seating for two boilers	238
Chimney	130
Boiler house	590
Induced draught fan and motor	61
Feed pumps	60
Feed pipes	41
Sluice pipes	18
	£2,399

30 per cent. of £2,399 used for winding engine = £720. Interest and depreciation at 10 per cent. = 1·97d. per hour. Cost of coals per fortnight = £45; per hour = 32·3d.; 30 per cent. of 32·3d. = 9·69d. Cost of stores per fortnight = 14s. 7d.; cost of repairs per fortnight = 17s. 1d.; total per hour = 1·13d.; 30 per cent. of 1·13d. = ·205d.* Firemen's wages per fortnight = £9 18s. 2d.; per hour = 7·08d.; 30 per cent. of 7·08d. = 2·124d. Coals drawn per fortnight = 6,815·7 tons; per hour = 20·28 tons.

CAPITAL COST OF WINDING ENGINE.

Engine house and pillar	£1,020
Engines	978
Steam pipes	80
Exhaust pipes	32
	£2,110

10 per cent. of £2,110 for depreciation and interest = £211; cost per hour = 5·78d. Stores and repairs per fortnight = £1 4s. 6d.; per hour = ·87d. Winding enginemen's wages per fortnight = £15 1s. 6d.; per hour = 10·76d.

The Park Pit winding engine was a similar engine to that at Bowburn Colliery. The cylinders were 19⅜ in. and 32 in. × 60 in., and the drum was 9 ft. in diameter. Steam was used at 150 lb. pressure per sq. in., and the engine was non-condensing. There was not a balance rope. The shaft was 400 ft. deep, and two tubs, each of 30 to 35 cwt., were wound at a time. The engine was capable of raising about 300 tons per hour. During the period over which the figures were taken, 35·2 tons were wound per hour. This engine was at a great disadvantage as regards cost of winding, as the boilers on which it worked were put down to supply steam to the rest of the engines at the mine; these engines were not put in, electric motors being put down instead, and power taken from the Cleveland and Durham Power Co. It was seen that the boiler charges were much heavier than they would have been had the rest of the machinery been steam-driven, as at first intended. This engine was put down in December, 1907.

	Cost, pence per hour.	Per ton per 1,000 ft.
Boilers and steam pipes to main stop valve (power)—		
Capital, 10 per cent. of £142	3·878d.	
Labour	6·5d.	
Coals	17·8d.	
Stores and repairs	·172d.	
Total	27·350d.	1·66d.
Winding Engine.		
Capital, 10 per cent. of £3,724	10·2d.	
Labour	7d.	
Stores and repairs	·59d.	
Total	17·79d.	1·08d.
Gross total		2·74d.

* This should be ·339d.—EDS. E.R.

CAPITAL COST OF BOILERS.

Boilers	£1,106
Chimney	150
Feed pump and pipes	100
Induced draught fan	60
	£1,416

Coals used per week (six days), £10 1s. 6d.; per hour, 16·8d. Stores and repairs for year, £6 5s. 10d.; per hour, ·172d. Fireman's wages for six days, £3 18s. 3; per hour, 6·5d. Tons raised per week, 5,912·9; per hour, 41·06d. Tons per hour per 1,000 ft. = 16·42.

CAPITAL COST OF WINDING ENGINE.

Engine house	£1,300
Engine	2,350
Steam and exhaust pipes	74
	£3,724

10 per cent. of £3,724 for depreciation and interest = £372; cost per hour, 10·2d. Stores and repairs per year = £26 11s. 2d.; per hour, ·59d. Winding engineman's wages six days = £4 3s. 8d.; per hour, 7d. Tons raised six days = 5,912·9; per hour, 41·06d.

MR. H. A. COUVES (Newcastle Electric Supply Co.) said that a large number of local collieries were drawing 700-800 tons per day, and he was sure that it would pay manufacturers to cater for the demand for suitable electric winders. As yet there were very few reliable comparative data as to costs, but the trouble was to get exact figures for the steam plants. He knew of a small Ilgner set working a 140-ft. shaft, and the consumption was only 50 units per 100 tons, and in another case of a 180-ft. shaft, 80 units per 100 tons, with a three-phase geared winder. Some engineers were so keen on exhaust turbine sets that they appeared to be ready to put down engines as exhaust steam producers. There was something to be said for the exhaust turbine sets where a large and expensive set of engines had been installed, but in such cases the local power companies were always ready to co-operate, by putting down waste-heat generating stations. It must not be considered that the installation of exhaust turbine plant was the last word in economical power production. Turbines cost money to keep in running order, and he knew of one breakdown which took five months to repair. Again, cooling towers were necessary, and he knew of two cases where these had to be completely renewed in less than five years. He wished to know if Mr. Mountain's figure of ·15d. per unit, generated by exhaust steam, included an ample allowance for repairs over a reasonable period of years.

MR. J. SCHUIL (A. Reyrolle & Co.) said that Mr. Wilson had not mentioned accumulator buffer batteries as a method of keeping down the peaks and equalising the load. It had been found in Germany that with the aid of such batteries a very undesirable load could be made a very desirable one. In the case of the Konigh. Bergenspektion zu Clausthal pit, a battery capable of giving 200 amperes for one hour was able to keep the bus-bar pressure constant to within 2½ per cent., although the peaks amounted to 800 amperes. Further figures for other plants showed that the efficiency and regulation were excellent, and the battery might be very small so long as it was capable of a high rate of discharge. Most of the previous speakers had assumed that the power factor of a three-phase motor was very low at starting, but figures kindly supplied to him by Dr. Rosenberg disproved this.

MR. W. C. MOUNTAIN (Scott & Mountain) quoted a number of data from a paper read the previous Saturday in Newcastle by Mr. Henry Moore Hudspeth, and he also quoted comparative figures for steam plants for the same duties, these having been obtained from first-class makers in this country. The figures given by him in his 1906 paper had been criticised, but he had recently had the following figures given to him in connection with the same installation: 4,200 tons per 15 hours from 1,626-ft. shaft, engines 2 × 40 in. × 78 in., cost of winding per 100 tons, including 5 per cent. interest and 10 per cent. depreciation, stores, coal, &c., was 5s. 2d.

MR. J. C. WILSON, in reply, said that the discussion had taken a turn he had not anticipated in that the question of steam *versus* electricity had been largely introduced. Mr. Mountain had given the limits of cost per 100 tons as 5s. and 16s., but they were even wider than this, taken over a large number of pits. To cite figures for a given pit and then to apply them generally was a most unphilosophical proceeding. It was not a question for general discussion, because each case had to be considered on its merits. Given a case, the relative costs could be determined with accuracy.

Physical Society of London.

AT a meeting held on November 25th, 1910, a paper entitled "The Electric Stress at which Ionisation begins in Air," was read by DR. A. RUSSELL. In the *Proceedings* of the American Institution of Electrical Engineers for July, 1910, Prof. J. B. Whitehead published the values of the electric stress at which ionisation begins in air. The electrodes he used in his experiments consisted of a metal tube and a cylindrical wire coaxial with it. Alternating pressures were employed, and the inner wires used had diameters varying in size from 0·089 to 0·475 cm. If a be the radius of the inner wire, the author has found that the expression $32 + 13{\cdot}4/\sqrt{a}$ gives all Whitehead's experimental results for the maximum electric stress in kilovolts per centimetre, with a maximum inaccuracy of less than 1 per cent. The experiments show that the electric stress at which ionisation occurs is independent of the metals used for the electrodes and of the inner radius of the outer tube. It depends merely on the radius of the inner wire. It is shown that Steinmetz's experimental results on the sparking distances between parallel rods are in substantial agreement with Whitehead's figures. Possible reasons for the discrepancies are given. An empirical formula is given which is based on experimental results recently published by Kowalski and Rappel for the sparking voltages between equal spherical electrodes. The results indicate that the electric stress at the moment of discharge has a minimum value when the distance between the electrodes is a certain function of their radius. The author lays great stress on the currents of electrified air which stream round the electrodes before the discharge takes place and the effects of which it is customary to neglect. These currents often modify very appreciably the values obtained for the disruptive stress at the moment of discharge. The striking similarity between the formulæ for the temperature gradient at the surface of a hot wire cooling in air and the empirical formula for the potential gradient at the surface of an electrified wire when ionisation is taking place at its surface is pointed out.

The author, in reply to the discussion, stated that the formulæ gave results which were in good agreement with those obtained by Watson and Rayner. Recent research had shown that the voltages between overhead wires at which luminous effects, disruptive discharges, sudden increases in the readings of the ammeters and wattmeters in circuit, and sudden violent ionisation began were practically the same.

A paper on "The Afterglow of Electric Discharge," was read by PROF. R. J. STRUTT.

It has long been known that when the electric discharge has passed at low pressure through certain gaseous mixtures, a luminosity survives for some seconds after the discharge has been turned off. A greatly improved method of experimenting on the phenomenon was introduced by Dewar (*Proc.* Roy. Inst. 1888). A powerful air-pump is used to draw a regulated current of gas through the vacuum tube. In this way a continuous removal of the gas from the region of discharge is effected, and the afterglow which it emits in passing through another vessel on its way to the pump can be examined continuously and at leisure.

Previous experimenters have connected the glow with ozone; additional evidence has been obtained pointing in this direction, and the glow has been shown to involve consumption of ozone. It is a flame of low temperature, arising from the oxidation of some other body by ozone. To determine the nature of this other body, a current of ozone from a vacuum-tube fed with oxygen was allowed to mix, in a Y-shaped tube, with any other gas which it was desired to test, on its way to the pump. This body proved to be nitric oxide. On leading a current of this gas into the ozone stream a very brilliant glow was obtained, of the characteristic yellow colour. By suitable arrangements this glow can be produced in the form of a pointed flame, with dark inner cone. The glow is not associated with a sensible rise of temperature; it is purely chemical in its origin. The main conclusion of the paper is that the ordinary yellow afterglow is due to oxidation of nitric oxide by ozone. The same results were obtained with air saturated with water vapour and air dried by means of phosphoric anhydride.

MR. J. S. DOW described a form of instrument, of specially portable and compact design, for the measurement of surface brightness or illumination. The observer looks through an aperture in a white screen, which is illuminated by means of a small glow lamp, at the surface to be studied. The illumination of the screen can then be varied by a special device which gives a uniform scale capable of being calibrated in foot-candles or lux, as desired. The instrument can be calibrated by observing any surface of known brightness, and a range of readings from 0·01 to 100 foot-candles can be secured. For this purpose two neutral dark glasses, each reducing the incident light to one-tenth, are employed. The device for adjusting the illumination of the screen in the apparatus is as follows:—The small glow lamp is set within a light-tight white chamber and illuminates a ground opal sector-shaped piece of glass at the end of it, with uniform intensity. Shutters can then be caused to travel in front of this glass, cutting off the area to a known extent, and causing a corresponding change in the resultant illumination. The instrument can be readily carried about by the observer, and applied to measure illumination or surface brightness in any plane and in inaccessible places.

Submarine Cables for Long-Distance Telephone Circuits.

By MAJOR W. A. J. O'MEARA, C.M.G., M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *London, December 15th*, 1910.)

(*Concluded from Vol. 67, page* 1085.)

APPENDIX VI.—*Specification for Anglo-French Submarine Telephone Cable.*

1. *Conductors.*—The conductor of each coil shall be of an approved stranded type, shall weigh not less than 160 lb. per knot, and shall at a temperature of 75° F. have a resistance not higher than 7·452 standard ohms per knot for a conductor of this gauge. The lay of the stranded conductor shall be left-handed.

2. *Insulator or Dielectric.*—The conductor of each coil shall be insulated by being covered with three alternate layers of Chatter-

ton's compound and gutta-percha, beginning with a layer of the said compound, and no more compound shall be used than may be necessary to secure adhesion between the conductor and the layers of gutta-percha. The dielectric on the conductor of each coil shall weigh not less than 300 lb. per knot, making the total weight of the conductor of each coil when covered with the dielectric, not less than 460 lb. per knot.

3. *Inductive Capacity.*—The inductive capacity of each coil of such insulated conductor (hereinafter called the core) shall not exceed 0·275 microfarad per knot, and this shall apply equally to the completed cable.

4. *Insertion of Loading Coils.*—The loading coils will be inserted so that diagonal cores in the cable will be used to form a loop or pair. Each pair of cores to be fitted with loading coils equally spaced at such distances apart and of such inductance and effective resistance as will make :—

(*a*) The volume of speech transmitted over a pair of wires in the completed and laid cable at least equal to that through one-seventh of the same length of standard cable not including terminal losses.*

(*b*) The quality of speech or articulation not inferior to that of the speech throughout the standard cable equivalent† of the loaded cable pair.

5. *Interference.*—The two loaded cable pairs to be free from telephonic induction or interference, the one from the other, and also from external disturbance from a continuous cable.

6. *Labelling.*—Each coil of core before being placed in the temperature tank for testing shall be carefully labelled with the exact length of conductor and the exact weight of copper and dielectric respectively which its contains.

7. *Insulation Resistance.*—The insulation resistance of each coil of core, after such coil shall have been kept in water maintained at a temperature of 75° F. for not less than 24 consecutive hours immediately preceding the test, shall be not less than 400 nor more than 2,000 megohms per knot, when tested at that actual temperature, and after electrification during one minute. The electrification between the first and the second minutes to be not less than 3 nor more than 8 per cent., and to progress steadily. The insulation to be taken not less than 14 days after manufacture.

Each coil of core may be subjected, before the ordinary insulation test is taken, to an alternating electromotive force of 5,000 volts and 100 complete periods per second for 15 minutes.

8. *Preservation.*—The core shall during the process of manufacture be carefully protected from sun and heat, and shall not be allowed to remain out of water.

9. *Joints.*—All joints shall be made by experienced workmen, and the contractor shall give timely notice to the Engineer-in-Chief or other authorised officer of the Postmaster-General whenever a joint is about to be made, in order that he may test the same. The contractor shall allow time for a thorough testing of each and every joint in the insulated trough by accumulation, and the leakage from any joint during one minute shall be not more than double that from an equal length of the perfect core.

10. *Taping and Serving.*—The cores to be four in number, and to be stranded with a left-handed lay, and during the process of stranding be wormed with best wet fully tanned jute yarn, so that the whole may be as nearly as possible of a cylindrical form, and shall then be covered (1) with cut cotton tape prepared with ozokerit compound ; (2) with pliable brass tape 0·004 in. in thickness and 1 in. in width ; and (3) with another serving of cotton tape, similar to the first ; the lap in each case being not less than 0·250 in.

The cores, prepared as above specified, shall then be served with best wet fully tanned jute yarn, sufficient to receive the sheathing, hereafter specified, and no loose threads shall, in the process of sheathing, be run through the closing machine. The cores so served shall be kept in tanned water at ordinary temperature, and shall not be allowed to remain out of water except so far as may be necessary to feed the closing machine.

11. *Sheathing.*—The served core to be sheathed with 16 galvanised iron wires, each wire having a diameter of 280 mils, or within 3 per cent. thereof above or below the same. The breaking weight of each wire to be not less than 3,500 lb., with a minimum of 10 twists in 6 in. The length of lay to be 18 in., and to be left-handed.

The wire to be of homogeneous iron, well and smoothly galvanised with zinc spelter. The galvanising will be tested by taking samples from any coil or coils, and plunging them into a saturated solution of sulphate of copper at 60° F., and allowing them to remain in the solution for 1 minute, when they will be withdrawn and wiped clean. The galvanising shall admit of this process being four times performed with each sample without there being, as there would be if the coating of zinc were too thin, any sign of a reddish deposit of metallic copper on the wire. If, after the examination of any particular quantity of iron wire, 10 per cent. of such wire does not meet all or any of the foregoing requirements, the whole of such quantity shall be rejected, and no such quantity, or any part thereof, shall on any account be presented for examination and testing, and this stipulation shall be deemed to be, and shall be treated, as an essential condition of the contract. Before being used for the sheathing of the cable, the wire shall be heated in a kiln or oven, just sufficiently to drive off all moisture, and whilst warm shall be dipped into pure hot gas-tar (freed from naphtha). The iron wire so dipped shall not be used for sheathing the cable until the coating of gas-tar is thoroughly set. No weld or braze in any one wire of the sheath shall be within 6 ft. of a weld or braze in any other wire. All welds or brazes made during the manufacture of the cable shall be re-galvanised and re-tarred.

12. *Compound and Serving.*—The sheathed cores shall be covered with two coatings of compound, and two servings of three-fly jute yarn, the said compound being placed between the two servings and over the outer serving of yarn aforesaid ; the two servings of yarn to be laid on in directions contrary to each other.

The compound referred to in this paragraph shall consist of pitch 85 per cent., bitumen 12½ per cent., and resin oil 2½ per cent., and the yarn referred to shall be spun from the best quality of jute, and shall be saturated with gas-tar freed from acid and ammonia, the yarn being thoroughly dried after saturation and before being used, so as to have no superfluous tar adhering.

13. *Measurement and Marks.*—A correct indicator shall be attached to the closing machine, and a mark to be appproved by the Engineer-in-Chief shall be made on the cable at the termination of each knot of completed cable, and also over each joint, or set of joints.

14. *Laying.*—If the tender for laying be accepted, the contractors shall provide the necessary cable-laying ship and all appliances and all apparatus in connection therewith for the laying and testing of the cable during the laying operations. Facilities must be provided for inspection of the work, if considered necessary, by an officer of the Postmaster-General during the progress of the laying operations.

The cable to be laid over the course shown by the dotted red line on the accompanying Admiralty Chart, or as hereafter agreed upon.

On completion of the laying operations the spare cable left on board is to be delivered at the Post Office Cable Depôt, Dover, or paid out and buoyed in the sea near Dover as may be directed by the Engineer-in-Chief.

15. The contractors are required to guarantee that the completed cable shall reach and maintain the standard laid down in the specification, and before final acceptance the cable shall be subject to such tests and experiments as the Postmaster-General may deem necessary during the manufacture, laying, and for a period of 30 consecutive days from the completion of the latter.

* Standard cable is that having a wire-to-wire capacity for each pair of wires of 0·054 microfarad per statute mile, a loop resistance of 88 ohms per statute mile, and an average insulation resistance of not less than 200 megohms per statute mile wire-to-wire.

† By the standard cable equivalent of any loop is meant the number of statute miles of loop in a standard cable through which the same volume of speech is obtained as through the loop under test.

Faraday Society.

The Separation of Oxygen by Cold.

In a paper bearing this title, Mr. James Swinburne, F.R.S., the President, presented to the Society at the December meeting, held on the 13th ult., a very valuable study of the problem of separating the constituents of air by means of extreme cold. The problem, of course, is essentially a thermodynamic one, but it is not the same as the mere liquefaction of air, since the separation of the oxygen and nitrogen involves in addition the expenditure of the work necessary to effect the separation. It will be impossible to reproduce in a short abstract the closely-reasoned argument on which Mr. Swinburne bases his conclusions ; for that, the original paper, which is well worthy of careful study, might be consulted. Suffice it to say that the ideal conditions to be aimed at involve both the energy and entropy equilibrium of a rectifying system in which air enters at some definite temperature and oxygen and nitrogen leave separately at the same temperature, heat being supplied at some point in the system to account for the energy required to bring about the separation. That energy is required for the separation is readily seen from the consideration of an ideal engine whose cylinder contains two semipermeable pistons, one permeable to oxygen but not to nitrogen, and the other permeable to nitrogen but not to oxygen. The analogy of an ordinary alcohol rectifier is pointed to as involving the necessary equilibrium conditions, working, however, at more familiar temperatures. In the ideal air rectifier, air is supposed to enter the apparatus at 90° A. (absolute). It passes to a cooler, where it is reduced to 82° A., a good deal being liquefied. The partly-condensed air then enters the rectifier, into which heat is supplied to separate the oxygen. From the rectifier, oxygen escapes at 90° A. and nitrogen at 77° A., which is increased to 90° A. during the passage of the gas through an interchanger, in which it interchanges heat with a portion of the incoming air at 90° A.

Thermodynamic engines take in heat from the cooler and deliver some of it to the rectifier and some to the outside. Assuming no irreversible process takes place inside, the system gives out heat and takes in work, and the heat for each kilogramme of air is 13,180 joules at 90° A. To separate a kilogramme of air at 0° C. needs 40,000 joules to be converted into heat, so to separate a kilogramme a minute requires 666 watts in a perfect machine—quite a reasonably small amount of power. If merely enriched oxygen is required less power is needed. Of course in practice there is leakage of heat and all sorts of irreversible changes of heat, and the thermodynamic engine will not be ideal, but allowing for all losses it turns out that to make a ton of oxygen on a large scale will need only 120 kw.-hours, and will cost only a shilling with electrical energy at 0·1d. a unit. This looks, says Mr. Swinburne, as if oxygen could be used for blast-furnace work, for if a blast furnace consumes 4½ tons of air per ton of iron, to increase the oxygen content by 10 per cent. will cost only 1¼d. per ton of pig.

Other gases could similarly be separated by cold. Thus hydrogen may be purified so that water-gas can be used as a source of balloon

gas. Indeed, the problem appears to have endless possibilities, and these should be borne in mind by all who are planning schemes for the production and utilisation of power in large quantities.

THE ELECTRO-ANALYSIS OF METALS.

At the same meeting a communication was read from Dr. Henry Sand and Mr. W. M. Smalley describing some improved apparatus for the rapid electro-analysis of metals. Usually in such apparatus platinum sheet or gauze is employed both for anode and cathodes. Dr. Sand and Mr. Smalley described an anode in which the amount of platinum used is reduced to a minimum, the whole framework being constructed of glass. For copper and zinc determinations—those most frequently required in practice—the use of platinum for the cathodes is altogether discarded, silver being substituted in the former case, and nickel in the latter. The copper deposit is easily removed from the silver by means of a hot dilute solution of sulphuric acid containing a little hydrogen peroxide, and some determinations quoted in the paper show that perfectly reliable results can be obtained with silver cathodes.

Street Lighting by Modern Electric Lamps.

AT the INSTITUTION OF ELECTRICAL ENGINEERS, BIRMINGHAM LOCAL SECTION, on December 14th, MR. HAYDN T. HARRISON gave an abstract of his paper, which was followed by an interesting discussion.

MR. MAURICE SOLOMON, referring to the conversion of Marylebone from gas to electric lighting, said he did not consider that the figures given for gas were based on an up-to-date, well-thought-out system. He had made careful comparisons of gas and electric systems, and his conclusion was that they were neck and neck; and he thought it would be better if electrical engineers realised this. The whole paper brought out one point in particular of supreme importance to the electrical engineer. It was absolutely necessary to design, as Mr. Harrison had done, proper reflectors and proper globes for use with any particular source of light. The flame arc lamp was undoubtedly the most efficient source of light electrical engineers had, but they must use with it proper reflectors and dioptric or other globes. Lamp globes should be standardised, and in buying, they should be able to specify how much of the light it was permissible to cut off. Up to the present engineers had devoted a great deal of time to increasing the efficiency of the source of light and then used an obsolete globe, which cut off an unknown portion, possibly 50 per cent., or more.

MR. R. A. CHATTOCK could not agree with Mr. Solomon that gas and electric light were practically equal as regards cost. On page 8 of the paper it was shown that gas would have to be supplied at 7d. per 1,000 cb. ft. in order to compete with electricity at 1d. per unit., and 7d. would be far too low to enable the gas companies to make a profit. Mr. Harrison had quoted 30 to 34 C.P. per cb. ft. of gas for high-pressure lighting, and he would like to know if this was when the mantles were new, or if it represented the average for the life of the mantle, because it was generally admitted that the mantle deteriorated very quickly from high pressure. He agreed to the great importance of the reflectors and dioptric globes, and believed that reflector arrangements with tungsten lamps would solve the question of street lighting in cities. He could not agree with the author that street lighting was better than a motor load. It might have practically the same load factor in itself, but it constituted a special service on account of the special mains required, particularly in outlying districts.

DR. W. E. SUMPNER pointed out that what was wanted for outdoor lighting was a lamp giving a maximum candle-power in a horizontal direction, or nearly so, while for interior lighting, the maximum candle-power should be downwards, or within 45 per cent. The former was a characteristic of the glow lamp, and the latter of the arc lamp; but lamps were used at present in exactly the opposite way. The flame arc lamp by enlarging the size of the brilliant area had improved distribution considerably. The tungsten-filament lamp was not only most suitable for interior lighting, but was just what was wanted for street lighting. It had the advantage over gas that it would remain perfectly clean, which meant that an efficient reflector could be used. Mr. Harrison had pointed out that in the design of reflectors the theoretical shape was not found to be the right one in practice; this was really because the theory was wrong, being based on the assumption that light was reflected by the ordinary laws of reflection, and not diffused. An enamelled zinc reflector sent off most of the light by diffusion in a way which depended upon the shape of the surface, and not upon the direction in which the light came on to the reflector. It was of no advantage to make comparisons between glow lamps and arc lamps, based simply on candle-power. Allowance must be made for the fact that the total quantity of light given out by the glow lamp was about 10 times its maximum candle-power, while the total quantity given out by the arc lamp was only about four times its maximum candle-power. There was thus a factor of two and a-half to bear in mind in the comparison.

MR. ANGOLD pointed out that comparisons with arc lamps should take into account the grade of carbon used. A high class of carbon would reduce the cost per candle-power considerably. He gathered that what Mr. Harrison had done in connection with the design of reflectors had been to try to reflect light which would be normally thrown upwards. Had anything been done to get some of the light which would be thrown across the street and use it up and down the street?

MR. HARRISON, in reply, said that his gas figures had been criticised as being prejudiced in favour of electric lighting. The gas journals seemed to think the same thing; but he had written a letter a few days previously to the *Gas World*, pointing out that the figures really were the results of tests made by the Alexander Wright Co., and related to the most modern types of gas apparatus. He could not agree with Dr. Sumpner as to the importance of spherical candle-power, which, in his opinion, was of no use to anybody except the scientist. What they wanted to get was the cost of light efficiency, and that depended upon other conditions than spherical candle-power. He thought he was setting a good example in this respect in stating the candle-power at the angles required. In street-lighting lamps, if there was ever going to be any rating at all, the rating ought to be at the angle where the two lights were equidistant and their illumination converged. This was the only rating useful for street lighting. With regard to the deterioration of high-pressure gas mantles, it was very difficult to get information on this point. The deterioration depended upon the pressure. If the pressure were high or variable, then the mantle must be renewed very often. In regard to the comparison of street lighting with motors as a load, he pointed out a further advantage in the former in that it was a splendid advertisement for the supply. This fact was recognised by the gas companies, who considered that they could sell gas cheaply for street lighting without loss, since it gave them a good advertisement.

A VISIT TO SOME GERMAN WORKS.

BY A. P. CHALKLEY, B.Sc.

DURING a recent visit to Germany, the writer had the opportunity of inspecting some of the larger factories in various parts of the country, and even though one expects to find signs of prosperity and enterprise, it is safe to say that no engineer can make such a visit without being much more impressed with the vastness and solidity of German industry than he anticipated. It must be at once admitted, however, that it is unfair to compare individual factories in the two countries, owing to the difference of conditions, and it is not an unreasonable claim of English firms to attribute the inferiority of their equipment and arrangement of works to the smallness of their capital and the excessive competition, which disadvantages do not exist in Germany, since, speaking generally, the engineering trade is in the hands of a comparatively few very large companies.

The home of the Diesel engine is, of course, in Germany, and the first motor of this type was made at the Augsburg works of the Maschinenfabrik-Augsburg-Nürnberg. These shops, where once practically nothing but steam engines were built, are now almost entirely given over to the manufacture of Diesel engines, except for the printing machinery which has for some time been a speciality of the firm. The works cover some 250 acres, and employ nearly 4,000 men, and rarely has work been going on at such high pressure as at present. Dozens and dozens of Diesel engines, in all stages of construction, are to be found at the works, a particularly striking feature being the large number of marine engines now building, the M.A.N. having, as is now well known, evolved a satisfactory reversible motor. Quite a majority of the Diesel engines for land work are of 1,000 H.P. in four cylinders, which is one of the standard sizes finding most favour on the Continent, particularly in Russia and Roumania, where oil is so exceedingly cheap. All the castings are made in the foundry at the works, except the steel castings, which are used for the marine engines in order to reduce the weight.

The factory at Nuremburg of the M.A.N. is considered to be a model works, and the reputation is well founded, the shops having been built in 1901, and advantage taken of all modern improvements. It is here that the famous Nuremburg gas engines are built, though they form only part of the manufactures, among the others being steam turbines (Zoelly type), railway trucks, general structural work, and cranes. At present several twin tandem engines, of 3,000 to 4,000 B.H.P., are in course of construction, and it is to be noted that these engines cannot be tested in the works, and are not seen until actually being set to work on the site of their installation. The power station of the Nuremburg factory is quite an imposing building, and contains very large reciprocating sets, while an interesting point in connection with the boilers is that some of them are wood-fired, using only the sawdust from the sawmills, which is exhausted into pipes and led direct to the boiler house,

A complete visit to the A.E.G. works in Berlin is a long business, but in some respects they are the most remarkable in Europe and well repay the time spent. There are seven factories in various parts of Berlin, in some of the busiest quarters, employing 41,000 men, while the administration is carried on from an enormous central building in which are 1,700 officials. All the factories are in the midst of populous districts, consisting chiefly of large flats built by the company by their own workmen, and they are mostly several-storied buildings of brick with some substantial pretensions, having been designed by an eminent architect. The turbine shops are at present very well filled, though most of the very large turbo-alternators for the Rand (12,000 KW.) have now been dispatched, but the A.E.G. turbines have a very large sale on the Continent, particularly for large units, in spite of the relatively high price of the machines. In the same shops a good deal of auxiliary turbine machinery is now being constructed, such as turbine-driven feed pumps and circulating pumps, which the A.E.G. are developing to a large extent, while a speciality is made of small direct-current turbo-generators for ships. A visit to the dynamo and motor factory gives one a vivid impression of the present day German industry. Every available inch of the huge shops is filled with motors and dynamos of every conceivable description, and an idea of the rate at which work is carried out may be gleaned from the fact that the normal output of motors has lately been quadrupled. The shops are arranged so that the work passes from one end to the other continuously in its various stages of completion, being delivered into stock, or direct into railway trucks, at the top end after testing, while each type of motor is kept in the specified department. Numbers of motors are commenced upon with the idea of placing them in stock, but the rule is that before they are half finished they are sold. The shops are designed so that the doors leading from the offices open direct to that part of the factory where the motors, whose design and construction is controlled from these particular offices, are being built, the offices being at the same time so arranged that no noise is heard therein from the works. In most cases, somewhat contrary to English practice, the men work in gangs, and are paid by piecework *per gang*, so that any workman not doing his fair share of work is soon brought to book by the others in the same gang.

In the other German works which were visited the same general air of prosperity was present, though it is true this may to some extent be fictitious for various reasons. In the first place, the number of German engineering firms, compared with the English ones, is, as previously stated, very few, and consequently all the trade is in smaller channels which will necessarily be full. Again, there is no doubt that there is a good deal of work undertaken at unremunerative prices, partly in order to capture certain trades (*e.g.*, English), and partly to ensure a large turnover at any cost. It is certain that a trade once captured is difficult to regain, and it is in this respect that we have much to fear.

Power Supply and Military Considerations.—It is announced that the managers of the Rheinfelden Electricity Works and of the Laufenburg Electricity Works have arranged that either works can only supply electric power for the operation of Swiss Federal railways in agreement with the other works, and with the latter participating in the profits. The Federal Railway authorities, it is said, have declined the offer made by the Laufenburg Works to furnish power on the ground that the works are situated on the frontier. This means that for military reasons the railway authorities do not feel disposed to proceed with schemes for the conversion to electric traction of lines which would be dependent upon power stations capable of being easily disorganised by hostile forces. Similar considerations have partly hampered electric railway work in Germany, and will continue to impede progress in this direction, although no suggestions have ever been made that power should be obtained from generating stations near the frontiers of that country.

The Limerick Vacancy.—At a meeting of the Limerick Lighting Committee, a report was read from Mr. Clayton, to whom the 73 applications for the post of borough electrical engineer were referred. Mr. Clayton stated that in his judgment 10 of the applicants were qualified for the appointment. The selection of one of the 10 will be made at a later date.

THE REGISTRATION OF COLLIERY ELECTRICIANS.

By F. COX.

As many of your readers are already aware, the question of the registration of colliery electricians was the subject of a proposition on the agenda of the Labour Party Conference at Newport in 1910. Although much has been written and said on this question, there remains in the minds of some people a doubt as to the benefits or otherwise that such a scheme would bring with it. What I shall endeavour to do in the following remarks is to show that this proposal is one of the few conferring mutual benefits upon all classes concerned.

To anyone closely connected with mining matters the development and use of electricity in mines is undoubtedly the most outstanding feature in the progress of mining engineering. In the early stages of its growth as a power in mines, very low pressures were used, which did not necessitate very stringent regulations on the part of the Home Office.

As it has become more adapted to power work, higher pressures have come into vogue. The many accidents, the causes of which were traceable to the use of electricity in mines, called the attention of the authorities to this question, with the result that special regulations for the installation and use of electricity in mines were issued. These regulations have not in any way impeded the growth of electricity as used in mines; on the other hand, it would be quite safe to say that their effect has been of a stimulating nature.

While it is admitted that they are, in themselves, of a satisfactory kind, there yet remains to be done, at some future time, that which will secure the working with safety of those regulations—*i.e.*, the registration of the colliery electrician.

There are many instances of occupations in which life and limb are endangered where the Government require the persons in charge to be registered. Does anyone suffer because of the registration? Does the occupation suffer? The answer is, No! Looking just briefly at the mining and maritime occupations, which are the two most dangerous occupations, it can be imagined what would be the result if the colliery managers or ship captains were not certified and experienced men.

Now, I ask you to look at this new industry which is rapidly growing, and decide whether registration would be beneficial or not. It must be looked at from the point of view of a new danger that has been introduced into the mines, requiring efficient and experienced men to see the regulations carried out.

I will here quote the proposition on the agenda of the Labour Party Conference, which, I may add, now represents the miners of this country:—"That the rules governing the use of electricity in mines will not be effective unless a scheme of registration for electricians employed in mines be embodied in the same." This is not only the opinion of the practical miners, but also of many mining engineers and managers fully qualified to judge.

The particular form that this registration should take must, of course, form the subject of a special inquiry, but it is well recognised that there should be embodied in it a test as to experience, theoretical knowledge, and suitability generally. It has been suggested that such a test would be suitable if based on the same lines as that required in the case of seagoing engineers. Registration must, to be effective, involve some recognised standard of efficiency and experience to give a status to the colliery electrical engineer.

It may be advisable to review some of the beneficial effects such a scheme would have on those intimately concerned.

As indicated in the proposition, the colliery electricians are the chief persons concerned. It is to their lack of status that they attribute most of the deplorable things that occur. The position of colliery electrician is one of very great importance, but there is yet lacking the official stamp, the guarantee of efficiency. There are very few colliery electricians who do not feel the necessity for a scheme of registration, assuming, of course, that it would contain a

test of experience and efficiency. For similar objects there was formed recently the Association of Mining Electrical Engineers. The benefits accruing from such a scheme to the electrician are very obvious. In the first place, it would eliminate most of the competition for posts as colliery electricians; it is certain it would reduce the number of applicants to those considered sufficiently experienced and capable. It would follow also that the position of colliery electrician would become more permanent, and that an incentive to efficiency would be instituted. Lastly, having got registration, it would be no difficult matter to organise for any other desirable purpose.

While the advantages accruing to the colliery electrician are very definite, there are many and no less definite ones to be gained by the mine-owners and managers. It is notorious in mining circles that a considerable amount of inconvenience and loss is entailed by the constant change of officials. It is no easy matter to fill the post of colliery electrician with a suitable and reliable man, and I submit that the scheme under consideration would do a great deal towards selecting such a man for the position. Further, there is no doubt that a great amount of responsibility would be transferred from the colliery manager to the electrician in consequence of registration. Even the offer of good salaries under our present system of filling vacant situations does not assure the appointment of suitable men. What is really wanted is some standard of efficiency by which a reliable man may be judged. It is clear that a scheme which would protect the employer from inexperienced men being appointed to positions of trust would certainly minimise accidents, and it should receive his approbation and support. Among the many ways in which the colliery manager is capable of co-operating with the Government in safeguarding employés, this question is of some importance. Whilst accidents are prevented as far as possible, under the present regulations, the addition of this registration would make towards still greater efficiency, and above everything else it is justified on that account. There seems no valid reason why this proposal should conflict with the interests of the mine-owners; on the contrary, there is every reason to believe that it would receive some assistance from that direction.

In conclusion, the fact that the registration of colliery electricians is desirable from the different points of view of the employed, the employers, the general public, and, most important of all, the Government, constitutes such a powerful advocacy which must of necessity bring about, in the near future, the desired legislation.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SPAIN.

It is imperative that the exact net and gross weights in kilogs. of goods imported into Spain should be marked on the packages and specified on invoices, bills of lading and certificates of origin. The net weight of each class of goods should be stated, and the origin of goods should be declared on all documents.

In order that British goods on importation into Spain may enjoy the benefit of the treaty rates of Customs duty, or those set forth in the second column of the tariff, a certificate proving their British origin must be presented to the Customs. Goods exported to Spain from a treaty country and accompanied by a certificate of origin, may pass in transit through another treaty country without necessitating further formalities, but a special certificate will be required if they pass in transit through a non-treaty country. The production of a certificate of origin is dispensed with in the case of certain articles. Information as to the goods for which certificates are not required may be obtained from the Spanish Chamber of Commerce in London, Trinity Square, E.C., by whom certificates are issued.

Certificates of origin are issued either on the declaration of the producer or manufacturer of the goods, or of the holder of their power of attorney, to the effect that they are of his manufacture, or the product of his industry, or on that of a registered merchant ("comerciante matriculado") presenting reliable invoices relating to the merchandise. In the latter case the name of the manufacturer or producer need not be stated in the certificate. Certificates are issued either on a declaration signed and presented by the applicant to the proper authority, or on a verbal declaration before such authority. In the former case the fact shall be stated in the certificate that it was applied for on a written declaration, and in the latter case the certificate shall contain the signature of the person making the declaration underneath the words, "so declared under my responsibility." When the manufacturer shall himself apply for the certificate, his name, residence and domicile must be stated therein. When the certificate is applied for by his representative, the latter's name, residence and domicile must also be stated besides those of the manufacturer; and when the certificates are issued at the request of a registered merchant, his name, residence and domicile shall be given therein.

Certificates of origin are liable to a stamp fee of 2 pesetas.

In order that goods requiring a certificate and destined for deposit in the Customs warehouse may be subject to the duties of the second tariff, the said certificate must be produced at the time of the clearance of the goods for consumption.

The original regulations affecting certificates of origin, which were re-enacted by the Tariff Law of 1900 and again by the Tariff Law of 1906 in the modified form set forth above, were published in 1897, and it was then represented to the Spanish Government that there was no licensing or registration of merchants in England corresponding to that implied by the term "comerciante matriculado," and the Spanish Government were asked to instruct the Customs officials to accept certificates without the insertion of the name of the producer of the goods on the declaration of *bonâ fide* traders known to the issuing authority. To this request the Spanish Government replied by proposing that the words "comerciante, negociante, &c., de esta plaza y cuya personalidad para el efecto es reconocida por el autoridad" (merchants or traders, &c., of this town whose qualification for this purpose is recognised by the issuing authority), should be substituted for the term "comerciante matriculado" in the form of certificate of origin used for British produce. This proposal was agreed to by the British Government, and an English translation of the form of certificate of origin which the Spanish Customs authorities have agreed to accept for British goods is as follows:—

CERTIFICATE OF ORIGIN.

We, { [Chamber of Commerce,] / [Mayor,] / [Magistrate,] / [or Collector of Customs] } (Note 1) certify that:

Mr. { Producer or manufacturer, / Holder of power of attorney of producer or manufacturer [holder of power of attorney of Mr. residing]. / Merchant or trader, &c., of this town, whose qualification for the purpose is recognised by us, } (Note 2)

residing in Street, has declared before us, on his responsibility, that the merchandise designated below is of origin and production (Note 3), as shown by reliable invoices presented to us by the consignor (Note 4), which merchandise is to be shipped to [place of destination in Spain], consigned to merchant or manufacturer at [place of residence in Spain].

No. and description of cases.	Marks.	Numbering.	Gross weight. Kilogs.	Contents (Note 5).

So declared under my responsibility.

[Signature of person declaring.] (Note 6.)

[Date and signature of the authority issuing certificate.]

Consular *visa*. No.

Seen at this Consulate for the legalisation of the signature of the issuing Authority.

This certificate is good for not more than months from the date of *visa*.

[Date, signature, and seal of Consulate.]

NOTES.

Note 1.—Spanish Consuls can also issue certificates of origin when specially authorised to do so.

Note 2.—The formula to be used depends on the quality of the applicant for the certificate of origin. The two not used must be crossed out.

Note 3.—When the certificate is issued on the application of the producer or the holder of his power of attorney, the expression "is of { my / his } manufacture" must be substituted for the words "is of origin and production."

Note 4.—The words "as shown by reliable invoices presented to us by the applicant" must be omitted if the declaration is made by (1) the producer or manufacturer, or (2) the holder of his power of attorney. When the certificate is applied for by (3) the merchant or trader, the name of the manufacturer or producer may be omitted.

Note 5.—The expression "contents" refers to the material and class of merchandise. In yarns and textiles it must be expressly stated whether these are of cotton, jute, flax, wool, or silk, or a mixture of these materials.

Note 6.—The expression "so declared on my responsibility" will not be employed in those cases where the application has been made to the authority by written and signed petition, in conformity with the regulations of each country.

(To be continued.)

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this Journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

29,410. "Improvements in automatically-actuated points for electrical railways and the like." E. FEHR. December 19th.

29,425. "New way of locking electric lamps and the like." E. CHEADLE, son. December 19th.

29,441. "Improved automatic switch for use in connection with electrically-driven or electrically-controlled machines." F. JACKSON and G. E. PEARSON. December 19th.

29,452. "Improvements in electric illuminating signs." W. W. ARNOLD. December 19th.

29,456. "Electric switch operating mechanism." A. JOHNSCHLER. December 19th.

29,463. "Improvements in and relating to automatic electric heat control." H. G. GEISSINGER. (Date applied for under Sec. 91 of the Act, December 22nd, 1909, being date of application in United States.) December 19th. (Complete.)

29,473. "Improvements in and relating to electroplating apparatus." H. E. PUCKLITZSCH. December 19th. (Complete.)

29,489. "Improvements in and relating to sparking plugs." J. C. ANDERSON. December 19th. (Complete.)

29,493. "Improvements in and relating to self-regulating dynamo-electric machines." C. A. VANDERVELL and A. H. MIDGLEY. (Application for Patent of Addition to No. 25,588, 1910.) December 19th.

29,505. "Improvements in supports for metallic-filaments in electric incandescent lamps." A. H. ARENDT (trading as Allgemeines Chemisches Laboratorium). (Date applied for under Sec. 91 of the Act, December 18th, 1909, being date of application in Germany.) December 19th. (Complete.)

29,506. "Improvements in electric arc lamps." R. SCHMIDT. (Date applied for under Sec. 91 of the Act, December 20th, 1909, being date of application in Germany.) December 19th. (Complete.)

29,511. "Improvements in methods of clearing faults in alternating current high tension systems." A. M. TAYLOR. December 20th.

29,549. "Improvements in or relating to the regulation of alternating current generators working in parallel." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens-Schuckertwerke, G.m.b.H., Germany.) (Complete.)

29,593. "Improvements in and relating to electric motors." W. R. MACDONALD. December 20th. (Complete.)

29,616. "Improvements in and relating to intercommunication telephone systems." R. L. MURRAY and G. BURNEY. December 20th. (Complete.)

29,631. "Improvements in fuse-boxes for controlling electric circuits." V. HOPE. December 21st.

29,630. "Improvements in electrical bell bushes." J. C. KEMPTON and W. H. ALLWORK. December 21st.

29,654. "Improvements in or relating to electrical impulse transmitting or calling devices for telephone systems." S. G. S. DICKER. (Automatic Electric Co., United States.) (Date applied for under Rule 13, January 18th, 1910. An invention comprised in Application No. 1,298, dated January 18th, 1910.) December 21st. (Complete.)

29,672. "Improvements in telephone exchange circuits." SIEMENS BROS. AND CO., LTD. (Siemens & Halske Akt.-Ges., Germany.) December 21st. (Complete.)

29,684. "Improvements in and relating to apparatus for duplex telegraphy." W. JUDD, B. DAVIES and A. HARDIE. December 21st.

29,685. "Improvement in telephones." P. CLIMENT. (Date applied for under Sec. 91 of the Act, June 30th, 1910, being date of application in Spain.) December 21st. (Complete.)

29,714. "Gun for cartridges with electric pruning." A. TEPINS. December 21st. (Complete.)

29,715. "Improvements in revolving electrical furnaces." O. SERPEK. (Application for Patent of Addition to No. 29,299/10.) December 21st. (Complete.)

29,719. "Improved method of and apparatus for igniting explosive mixtures." D. B. HUGHES. December 21st. (Complete.)

29,726. "Improvements in electrically-operated driving systems." CROMPTON AND CO., LTD. and H. BURGE. December 21st. (Complete.)

29,727. "Improved means for controlling electrically-operated driving systems." CROMPTON & CO., LTD., J. C. MACFARLANE, H. BURGE and A. WILLIAMS. December 21st. (Complete.)

29,728. "Improved means for regulating electrically-operated driving systems." CROMPTON & CO., LTD., J. C. MACFARLANE, H. BURGE and A. WILLIAMS. December 21st. (Complete.)

29,733. "Improvements in and relating to electric water-heaters." H. N. ROCHE. (Date applied for under Sec. 91 of the Act, December 21st, 1909, being date of application in United States.) December 21st. (Complete.)

29,734. "Improvements in eddy current absorption brakes." J. G. P. THOMAS. December 22nd.

29,741. "Improvements in conduits for electric wires." E. DEWHURST. December 22nd.

29,747. "Improvements in electric clocks." H. B. SWIFT and W. D. BAXTER. December 22nd.

29,763. "Improvements in watertight electric incandescent lampholders." B. J. GRIGSBY. December 22nd.

29,778. "New or improved apparatus for use in electro-plating." S. O. COWPER-COLES. December 22nd.

29,810. "Automatic distributor for electricity." H. A. WOLFF. December 22nd. (Complete.)

29,833. "Improvements relating to the transmission and reproduction of sound by electrical means." S. G. BROWN. December 22nd.

29,849. "Improvements in or relating to incandescent electric lamps." H. D. STANIAR and A. E. CLEGG. (M. Bach, Germany.) December 23rd.

29,854. "Improved travelling apparatus for the overhead support of electric lamps." J. W. F. WARREN and J. W. GOUNDRY. December 23rd.

29,856. "Improvements in starting, regulating and controlling switches for electric motors and the like." H. DEAN. December 23rd.

29,857. "Improvements in starting, controlling and regulating switches for electrical generators and motors." H. DEAN. December 23rd.

29,863. "Improved means for automatically regulating the flow of an electric current from a dynamo." A. N. HAZELHURST and LONGSTRETH'S, LTD. December 23rd.

29,877. "Improvements in or relating to the distribution of electrical energy." W. R. RAWLINGS and E. G. NICHOLSON. December 23rd.

29,937. "Improvements in and relating to the measurement of electrical power." G. NORTH. December 23rd.

29,941. "Improvements in dynamo-electric machines." F. R. KUNKEL. (Date applied for under Sec. 91 of the Act, December 29th, 1909, being date of application in United States.) December 23rd. (Complete.)

29,980. "Improvements in and relating to circuit-breaking safety devices for electrical apparatus and the like." EVERSHED & VIGNOLES. December 24th. (Complete.)

29,981. "Improvements in the art of telegraphy." C. G. BURKE. December 24th. (Complete.)

29,992. "Improvements relating to electric heating and cooking apparatus." T. & J. JACKSON, LTD., and F. H. WILLIAMS. December 24th.

30,003. "Improvements in or connected with multiplex telephony and telegraphy." G. O. SQUIER. December 24th. (Complete.)

30,017. "Improvements in and relating to synchronising devices." C. GALLOWAY and R. A. HOLDEN. December 24th.

30,023. "Testing transmitter for sprinkler supervisory systems." F. J. BROUGHAM. (Dominion Guarantee Co., Canada.) December 24th. (Complete.)

30,024. "Electric supervisory systems for sprinkler systems." F. J. BROUGHAM. (Dominion Guarantee Co., Canada.) December 24th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

DYNAMO-ELECTRIC MACHINES. M. Walker. 27,968. November 30th.

ELECTRIC IGNITION DEVICES FOR INTERNAL-COMBUSTION ENGINES. D. Maggiora. 28,878. December 4th.

ELECTRO-MECHANICAL POWER TRANSMISSION. C. Cleiren. 29,995. December 22nd. (Date applied for under International Convention, December 24th, 1908. Application for Patent of Addition to No. 4,630 of 1908.)

ELECTRIC MOTOR STARTERS AND THE LIKE. H. R. Schultz. 30,184. December 24th.

METHODS OF UTILISING RADIANT ENERGY. R. A. Fessenden. 28,577. December 7th. (Date applied for under International Convention, March 8th, 1909.)

SYSTEMS OF SHIP PROPULSION. British Thomson-Houston Co. (General Electric Co.) 29,255. December 14th.

1910

ELECTRIC SWITCH APPARATUS. G. Sweetser and Electric Sign and General Advertising Co. 15,037. June 22nd.

APPARATUS FOR PRODUCING ELECTRICAL IMPULSE CHARGES FOR WIRELESS TELEGRAPHY AND TELEPHONY. S. Eisenstein. 16,354. July 8th. (Application for Patent of Addition to No. 10,019 of 1908.)

WINDING APPARATUS FOR COILS OR THE LIKE FOR ELECTRICAL AND OTHER APPARATUS. E. Haefely. 18,151. July 30th.

ALTERNATING-CURRENT ELECTROMAGNETS. W. J. P. Orton. 620. January 10th.

ELECTROMAGNETICALLY OPERATED INSTRUMENTS FOR CUTTING OUT STENCIL BANDS FOR COLOURING CINEMATOGRAPHIC FILMS. R. W. James. (Compagnie Generale de Phonographes, Cinematographes et Appareils de Precision.) 2,410. January 31st.

PROCESS FOR THE PRODUCTION OF ELECTRIC INSULATING LAYERS OF OXIDE ON METAL WIRES OR BANDS. Specialfabrik fur Aluminium-Spulen und Leitungen Ges. 2,711. February 3rd. (Date applied for under International Convention, February 5th, 1909.)

SAFETY APPARATUS FOR USE WITH ELECTRICAL INSTALLATIONS. W. Winsborough. 3,019. February 7th.

STARTING-SWITCHES FOR ELECTRIC MOTORS. I. Holmes. 4,744. February 25th.

TELEGRAPHIC TRANSMITTERS. F. G. Creed and W. A. Coulson. 5,374. March 3rd.

CONNECTION OF SINGLE-PHASE MOTORS TO POLYPHASE CIRCUITS. Akt.-Ges. Brown, Boveri et Cie. 6,402. March 14th. (Date applied for under International Convention, November 18th, 1909.)

ELECTRIC CONTACT DEVICES FOR USE WITH MOVING CONDUCTORS. W. G. Housekeeper. 7,332. March 23rd. (Date applied for under International Convention, March 31st, 1909. Request under Sec. 19 of the Act not granted.)

CONTROLLERS FOR ELECTRIC MOTORS. Adams Manufacturing Co. (Cutler-Hammer Manufacturing Co.) 9,736. April 21st.

MAGNETO-ELECTRIC CURRENT GENERATORS. A. P. Juston. 9,772. April 21st. (Date applied for under International Convention, May 6th, 1909.)

ELECTRIC SWITCHES. Siemens Bros. Dynamo Works. (Siemens Schuckertwerke Ges.) 10,315. April 27th.

ELECTRIC FURNACES. F. A. J. Fitzgerald. 11,718. May 11th. (Date applied for under International Convention, May 13th, 1909.)

ELECTRIC INDUCTION SMELTING FURNACES. A. Hiorth. 12,214. May 18th. (Date applied for under International Convention, May 22nd, 1909.)

METHOD OF AND APPARATUS FOR TELEGRAPHICALLY TRANSMITTING AND REPRODUCING PICTURES AND THE LIKE. R. Tschorner. 13,101. May 28th. (Date applied for under International Convention, June 30th, 1909.)

MEANS FOR REGULATING DYNAMOS. J. L. Routin. 13,709. June 6th.

ELECTRIC CONTACTS UNDER CARPETS AND THE LIKE FOR ALARM SIGNALS AND OTHER PURPOSES. F. Marmion. 14,742. June 18th.

ELECTRIC SWITCHES. A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. 18,591. August 6th.

TELEPHONE TRANSMITTERS. Western Electric Co. (Western Electric Co.) 21,285. September 14th.

ELECTRICAL INDUCTION FURNACES. O. Mulacek and F. Hatlanek. 674. January 10th. (Date applied for under International Convention, March 2nd, 1909.)

ELECTRICAL APPARATUS FOR SUPPLYING TO A LINE CIRCUIT A DIRECT CURRENT WHICH PERIODICALLY FLOWS IN OPPOSITE DIRECTIONS. A. J. Boult. (International Telechronometer Co.) 849. January 12th.

WORKING OR CONTROLLING OF ELECTRICAL MACHINERY. Siemens Bros. Dynamo Works. (Siemens-Schuckertwerke Ges.) 1,716. January 22nd.

PROJECTION ARC LAMPS. R. Schmidt. 1,751. January 24th.

IGNITION DEVICES FOR INTERNAL-COMBUSTION ENGINES. C. L. Fortescue. 2,216. January 28th.

ELECTRICAL HEATING ELEMENTS. H. B. Binko and M. Mayer. 2,690. February 5th.

ELECTRICITY METER METERS. G. Hookham. 3,174. February 9th.

ELECTRIC MOTOR CONTROLLERS. Adams Manufacturing Co. (Cutler-Hammer Manufacturing Co.) 4,814. February 25th.

ELECTRIC INDUCTION FURNACES. F. J. Brougham. (Paldihütte Tiegel Gusztahlfabrik.) 5,266. March 2nd.

ELECTRIC ARC LAMPS. H. Malachowski. 5,660. March 4th. (Date applied for under International Convention, July 8th, 1909.)

MOVING-COIL ELECTRICAL RECORDING INSTRUMENTS. Compagnie pour la Fabrication des Compteurs et Materiel d'Usines à Gaz. 6,782. March 17th. (Date applied for under International Convention, May 15th, 1909.)

CONTROLLERS FOR ELECTRIC MOTORS. W. J. F. Fortington-Neave. 6,125. March 18th.

MAGNETIC BRAKES FOR TRAMWAY AND OTHER VEHICLES. J. P. Todd. 7,048. March 21st.

INCANDESCENT ELECTRIC LAMPS. S. Horvath. 7,373. March 24th.

SHUNT CIRCUIT TILTING DEVICES FOR MERCURY-VAPOUR LAMPS. W. C. Heraeus Ges. 8,196. April 4th. (Date applied for under International Convention, January 24th, 1910.)

CONDUITS AND CONDUIT FITTINGS FOR ELECTRIC WIRING. W. Wilkinson. 8,444. April 7th.